Final

Environmental Assessment

Boost-Back and Landing of the Falcon 9 Full Thrust First Stage at SLC-4 West

Vandenberg Air Force Base, California and Offshore Landing Contingency Option

25 April 2016

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FINDING OF NO SIGNIFICANT IMPACT
Boost-Back & Landing of the Falcon 9 First Stage at SLC-4 West Vandenberg Air Force Base, California and Offshore Landing Contingency Option

This Finding of No Significant Impact (FONSI) hereby incorporates by reference and attaches hereto the Final Environmental Assessment (EA), Boost-Back & Landing of the Falcon 9 First Stage at Space Launch Complex 4 West (SLC-4W), Vandenberg Air Force Base (VAFB), California and Offshore Landing Contingency Option. This EA considered all potential environmental impacts of the Proposed Action (Alternative 1), the Alternative Action (Alternative 2), and the No Action Alternative, including cumulative impacts, and identified management protective measures to avoid, prevent, or minimize environmental impacts.

PROPOSED ACTION (ALTERNATIVE 1)

The Proposed Action (Alternative 1) is Space Exploration Technologies Corporation's (SpaceX's) project on VAFB (Federal land). SpaceX developed it based on the purpose, need, and selection criteria discussed in Chapters 1 (Purpose of and Need for the Proposed Action) and 2 (Description of the Proposed Action and Alternatives) of the attached EA. SpaceX now operates the Falcon Launch Vehicle Program at SLC-4E on VAFB. SpaceX proposes using first stage recovery (boost-back and landing) by returning the Falcon 9 First Stage to SLC-4W for potential reuse up to six times per year. The Proposed Action includes: infrastructure improvements at SLC-4W; the boost-back maneuver (in-air), return flight, and landing of the Falcon 9 First Stage on the new SLC-4W pad, the boost-back and landing of the Falcon 9 First Stage on a barge specifically designed for the landing and located at least 31 mi. (50 km) offshore of VAFB; and implementation of an autonomous flight termination system for Falcon 9 launch and boost-back.

ALTERNATIVE 2

Under Alternative 2, constructing a SLC-4W landing pad would not occur. The Falcon 9 First Stage boost-back and landing would occur; however, the First Stage would land on a barge located 320 mi. (515 km) offshore of VAFB in the Pacific Ocean.

NO ACTION

Under the No Action Alternative, current Falcon 9 launch processes would continue without using the Falcon 9 First Stage boost-back capabilities. Depending on the trajectory of the launch vehicle, the First Stage would drop into the Pacific Ocean approximately 300–500 mi. (480–800 km) west of the Baja California coast in the Pacific Ocean. The First Stage would not be recovered and would subsequently sink. The No Action Alternative would not meet the Proposed Action's purpose and need; however, it was analyzed in the EA as the National Environmental Policy Act (NEPA) requires.

SUMMARY OF FINDINGS

The attached EA analyzed the potential environmental consequences of activities associated with the Proposed Action, Alternative 2, and the No Action Alternative. Based on the analysis,

the Proposed Action, Alternative 2, and the No Action Alternative would not result in individual or cumulatively significant impacts to the following resources: sound, water, cultural, geology and earth, human health and safety, hazardous materials and waste management, solid waste management, land use and aesthetics, transportation, Department of Transportation Act Section 4(f) Properties, and utilities. Potential adverse impacts were noted for the Proposed Action to the following resources (discussed below): air quality, biological, and Coastal Zone management.

Air Quality: During SLC-4W modifications, emissions from fugitive dust, construction equipment, and construction worker travel would cause adverse air quality impacts. During Falcon 9 First Stage boost-back and landing operations at SLC-4W and the contingency landing locations, emissions from employee vehicles and emissions from the Falcon 9 First Stage and support vessels would also cause adverse air quality impacts. However, none of the anticipated impacts would be significant (see EA Sections 3.1, Air Quality; and 4.1, Air Quality). Emissions from the Proposed Action would not exceed significance thresholds; therefore, no adverse impacts to the region's air quality would occur. Moreover, all environmental protection measures described in the EA would be implemented to decrease emissions during project activities. Therefore, the Proposed Action's impacts to air quality would not be significant.

Biological Resources: Constructing a new landing pad at SLC-4W could directly or indirectly adversely affect the federally endangered El Segundo blue butterfly (ESBB) and potential ESBB habitat. The United States (U.S.) Fish and Wildlife Service (USFWS) issued a Biological Opinion (CON 8-8-14-F-41; 22 December 2014) that concluded constructing a new SLC-4W landing pad was not likely to jeopardize the continued existence of the endangered ESBB. The Falcon 9 First Stage boost-back and landing at SLC-4W may potentially result in short-term temporary effects to biological resources within the overpressure zone. This zone may experience a sonic boom of up to 3.1 pounds per square foot (psf). Areas within approximately 14 mi. (22.5 km) of SLC-4W may experience landing engine noise levels up to 110 decibels (dB) during launches. These potential effects would be limited to behavioral disruption. In a letter dated 2 July 2015, the USFWS concurred with the U.S. Air Force that the Proposed Action may affect, but is not likely to adversely affect the federally threatened California red-legged frog and western snowy plover, and federally endangered California least tern and southern sea otter.

Under the contingency action of the Proposed Action, the Falcon 9 First Stage boost-back and landing on a barge located 31 mi. (50 km) offshore has the potential to affect seven federally listed marine mammal species, five federally listed turtles, three federally listed fish species, and 34 marine mammal species protected under the Marine Mammal Protection Act (MMPA) due to debris impact, acoustic impacts, and expended materials. The U.S. Air Force (USAF) received concurrence from National Marine Fisheries Service (NMFS) with its assessment that the activities associated with this contingency action may affect, but are not likely to adversely affect ESA-listed species. In addition, SpaceX has submitted an application to NMFS for an Incidental Harassment Authorization (IHA) for Level B harassment of marine mammals as a result of the Proposed Action. In response to the USAF's analysis of potential impacts to Essential Fish Habitat (EFH), NMFS concluded that the contingency action could have an

adverse effect on EFH over time as a result of the cumulative addition of marine debris to the sea floor. The USAF and SpaceX will coordinate with NMFS to develop or contribute to a marine debris removal program to offset these impacts.

Coastal Zone Resources: SLC-4W landing pad construction is not anticipated to adversely impact the coastal area's scenic and visual qualities. Pad construction would also not affect marine resources, including environmentally sensitive habitat areas, recreational boating use, or agricultural resources, because none of these coastal resources would occur at the proposed construction site. We expect potential effects on environmentally sensitive terrestrial habitats to be minimal and less than significant. We do not anticipate that constructing the SLC-4W landing pad will adversely affect the coastal zone, as defined by the CZMA and California Coastal Act (CCA).

Access to the coast at Wall and Surf Beaches would already be restricted during Falcon 9 launches due to security. The addition of the boost-back and landing procedure would not significantly lengthen the closure period. Therefore, we do not anticipate the Falcon 9 First Stage boost-back and SLC-4W landing will adversely affects the coastal zone, as defined by the CZMA and CCA.

For a contingency landing action, the U.S. Coast Guard would issue a Local Notice to Mariners that defines a Public Ship Avoidance Area around the contingency landing location to temporarily restrict recreational boat access to the area. Recreational boating within the coastal zone would only be temporarily delayed during transit of SpaceX's barge, tug, and support vessel.

For an unsuccessful landing attempt, the First Stage would explode and residual fuel (estimated to be between 50 and 100 gallons) would be released into the ocean. In addition, approximately 25 pieces of floating debris would be present after a First Stage explosion, which SpaceX would recover promptly. The U.S. Coast Guard would keep the Public Ship Avoidance Area in place until all floating debris had been removed from the water, typically several hours. Very light oils, including RP-1, are highly volatile, which means they evaporate quickly when exposed to the air. They are usually completely dissipated within 1–2 days after a spill. The probability of exposure to spilled RP-1 after first stage explosion is very small since the volume of spilled RP-1 would be small (50–100 gallons) and it would dissipate quickly (minutes). Therefore, spilled RP-1 would not have a significant effect on the coastal zone or coastal resources, as defined by the CZMA and CCA. Acoustic impacts associated with the Proposed Action may result in temporary and infrequent behavioral disturbance to marine mammal species, which would be covered under an IHA issued to SpaceX by NMFS (see above).

The USAF filed a Negative Determination (ND) for the Proposed Action for both concrete landing pad construction and boosting-back and landing the Falcon 9 First Stage launch vehicle. These NDs found that the Proposed Action would not adversely affect coastal zone resources. The California Coastal Commission issued letters to the USAF concurring with its NDs on 13 October 2014 and 31 August 2015 (ND-0035-14 and ND-0027-15).

PUBLIC REVIEW AND COMMENT

The AF made the Draft EA available for public review and comment for 30 days following the publication of the Notice of Availability (NOA) in the following newspapers: *Lompoc Record* and *Santa Maria Times*. The AF also distributed the Draft EA and FONSI per its current VAFB NEPA Distribution List, including the State Clearinghouse. Appendix H (Notice of Availability for Public Review, Proof of Delivery/Publication, Comments Received on Final Draft, and Responses) contains a copy of the NOA, proofs of publication, proof of library deliveries, VAFB's NEPA distribution list, and public comments received, including VAFB responses.

FINDING OF NO SIGNIFICANT IMPACT

Based on my review of the facts and analyses contained in the attached EA, conducted per the National Environmental Policy Act, 42 U.S. Code 4321 et seq., implementing Council on Environmental Quality Regulations, 40 Code of Federal Regulations (C.F.R.) 1500–1508, and 32 C.F.R. Part 989, *Environmental Impact Analysis Process*, I conclude that implementing the Proposed Action (chosen alternative), with incorporation of required environmental protection measures, will not have a significant effect on the human environment. Therefore, further analysis with an Environmental Impact Statement is not required and a FONSI is appropriate.

26 APR 16

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Command Civil Engineer

Date

Attachment: Final Environmental Assessment (2016) Boost-Back and Landing of the Falcon 9 First Stage at SLC-4 West Vandenberg Air Force Base, California and Offshore Landing Contingency Option

TABLE OF CONTENTS

1 PURPOSE OF AND NEED FOR THE PROPOSED ACTION 1

1.1 BACKGROUND 2
1.2 PURPOSE AND NEED 2
1.3 PROJECT LOCATION 3
1.4 SCOPE OF THE ENVIRONMENTAL ASSESSMENT 6
1.5 INTERAGENCY COORDINATION AND CONSULTATION 6
1.6 INTERGOVERNMENTAL COORDINATION AND CONSULTATION 7

2 DESCRIPTION OF THE PROPOSED ACTION AND ALTERNATIVES 9

2.1 INTRODUCTION 9
2.2 SELECTION CRITERIA 9
2.3 ALTERNATIVE 1 (PROPOSED ACTION) 10
2.3.1 SLC-4W INFRASTRUCTURE IMPROVEMENTS 11
2.3.2 FALCON 9 BOOST-BACK AND LANDING 14
2.3.3 AUTONOMOUS FLIGHT SAFETY SYSTEM 30
2.3.4 ENVIRONMENTAL PROTECTION MEASURES 30
2.4 ALTERNATIVE 2 – FIRST STAGE LANDING SITE ON DRONE SHIP IN PACIFIC OCEAN 39
2.5 NO-ACTION ALTERNATIVE 39
2.6 OTHER ALTERNATIVES CONSIDERED AND ELIMINATED FROM FURTHER ANALYSIS 40

3 AFFECTED ENVIRONMENT 43

3.1 AIR QUALITY 44
3.1.1 DEFINITION OF RESOURCE 44
3.1.2 REGIONAL SETTING 47
3.1.3 REGION OF INFLUENCE 48
3.1.4 FEDERAL REQUIREMENTS 48
3.1.5 LOCAL REQUIREMENTS 49
3.2 SOUND (AIRBORNE) 50
3.2.1 REGION OF INFLUENCE 50
3.2.2 SOUND CHARACTERISTICS 50
3.2.3 SOUND SPECTRUM 51
3.2.4 SOUND METRICS 52
3.2.5 SOUND INTENSITY AND PERCEPTION 53
3.2.6 SOUND PROPAGATION 54
3.2.7 TIME-AVERAGED SOUND LEVELS 55
3.2.8 AMBIENT SOUND GUIDANCE DOCUMENTS 55
3.2.9 SENSITIVE RECEPTORS 55
3.3 BIOLOGICAL RESOURCES 56
3.3.1 REGION OF INFLUENCE 57
3.3.2 METHODOLOGY 57

3.3.3 Vegetation Resources 58
3.3.4 Wildlife Resources 59
3.3.5 Special Status Wildlife Species in the Terrestrial Portion of the Project Area 60
3.3.6 Special Status Species in the Marine Portion of the Project Area 72
3.3.7 Sensitive Marine Habitats 97
3.4 Water Resources 99
3.4.1 Region of Influence 99
3.4.2 Surface Water 104
3.4.3 Groundwater 104
3.4.4 Wetlands and Waters of the United States 104
3.5 Cultural Resources 105
3.5.1 Region of Influence 105
3.5.2 Cultural Resources within the Project Area 106
3.6 Geology and Earth Resources 107
3.7 Human Health and Safety 108
3.7.1 Region of Influence 108
3.7.2 Construction Activities 109
3.7.3 General Public and On-Base Personnel Safety 110
3.7.4 Security and Anti-Terrorism 111
3.7.5 Existing Noise Environment 111
3.8 Hazardous Materials and Waste Management 112
3.8.1 Region of Influence 112
3.8.2 Hazardous Materials at VAFB 112
3.8.3 Hazardous Waste at VAFB 112
3.8.4 Toxic Release Contingency Plans and Toxic Hazard Corridors 113
3.8.5 Environmental Restoration Program at VAFB 113
3.8.6 Military Munitions Response Program 116
3.9 Solid Waste Management 116
3.9.1 Construction Debris 117
3.9.2 Pollution Prevention 117
3.10 Land Use and Aesthetics 117
3.10.1 Land Use 119
3.10.2 Aesthetics 119
3.11 Coastal Zone Management 120
3.12 Transportation 121
3.12.1 Regional Access 121
3.13 Department of Transportation Act Section 4(f) Properties 123
3.14 Utilities 124
3.14.1 Electrical 124
3.14.2 Communications 124
3.14.3 Water 125
3.14.4 Wastewater Treatment 125

4 ENVIRONMENTAL CONSEQUENCES 127

4.1 Air Quality 127
4.1.1 Alternative 1 (Proposed Action) 128

4.1.2 Alternative 2 133
4.1.3 No Action Alternative 133
4.1.4 Greenhouse Gas Emissions 133
4.2 Sound (Airborne) 136
4.2.1 Approach to Analysis 137
4.2.2 Alternative 1 (Proposed Action) 137
4.2.3 Alternative 2 140
4.2.4 No Action Alternative 140
4.3 Biological Resources 141
4.3.1 Alternative 1 (Proposed Action) 142
4.3.2 Alternative 2 176
4.3.3 No Action Alternative 176
4.4 Water Resources 176
4.4.1 Alternative 1 (Proposed Action) 176
4.4.2 Alternative 2 178
4.4.3 No Action Alternative 178
4.5 Cultural Resources 178
4.5.1 Alternative 1 (Proposed Action) 179
4.5.2 Alternative 2 180
4.5.3 No Action Alternative 180
4.6 Geology and Earth Resources 180
4.6.1 Alternative 1 (Proposed Action) 180
4.6.2 Alternative 2 181
4.6.3 No Action Alternative 181
4.7 Human Health and Safety 181
4.7.1 Alternative 1 (Proposed Action) 181
4.7.2 Alternative 2 183
4.7.3 No Action Alternative 183
4.8 Hazardous Materials and Waste Management 183
4.8.1 Alternative 1 (Proposed Action) 183
4.8.2 Alternative 2 185
4.8.3 No Action Alternative 185
4.9 Solid Waste Management 185
4.9.1 Alternative 1 (Proposed Action) 185
4.9.2 Alternative 2 186
4.9.3 No Action Alternative 186
4.10 Land Use and Aesthetics 187
4.10.1 Alternative 1 (Proposed Action) 187
4.10.2 Alternative 2 187
4.10.3 No Action Alternative 187
4.11 Coastal Zone Management 187
4.11.1 Alternative 1 (Proposed Action) 188
4.11.2 Alternative 2 190
4.11.3 No Action Alternative 190
4.12 Transportation 190
4.12.1 Alternative 1 (Proposed Action) 190
4.12.2 Alternative 2 191
4.12.3 No Action Alternative 191

4.13 DEPARTMENT OF TRANSPORTATION ACT SECTION 4(F) PROPERTIES 191
4.13.1 ALTERNATIVE 1 (PROPOSED ACTION) 191
4.13.2 ALTERNATIVE 2 192
4.13.3 NO ACTION ALTERNATIVE 192
4.14 UTILITIES 192
4.14.1 ALTERNATIVE 1 (PROPOSED ACTION) 192
4.14.2 ALTERNATIVE 2 193
4.14.3 NO ACTION ALTERNATIVE 193
4.15 CUMULATIVE IMPACTS 193
4.15.1 PAST, PRESENT, AND REASONABLY FORESEEABLE FUTURE ACTIONS IN THE REGION OF INFLUENCE 193
4.15.2 ALTERNATIVE 1 (PROPOSED ACTION) 199
4.15.3 ALTERNATIVE 2 203

5 LIST OF PREPARERS 204

6 LIST OF AGENCIES, ORGANIZATIONS, AND PERSONS CONTACTED 205

7 BIBLIOGRAPHY 206

APPENDICES

APPENDIX A: INTERAGENCY AND INTERGOVERNMENTAL COORDINATION FOR ENVIRONMENTAL PLANNING

APPENDIX B: CALIFORNIA COASTAL COMMISSION CONSULTATION

APPENDIX C: STATE HISTORIC PRESERVATION OFFICE CONSULTATION

APPENDIX D: UNITED STATES FISH AND WILDLIFE CONSULTATIONS

APPENDIX E: NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION, NATIONAL MARINE FISHERIES SERVICE CONSULTATION

APPENDIX F: NATIVE AMERICAN TRIBAL CONSULTATION

APPENDIX G: SPECIES OBSERVED DURING FIELD SURVEYS

APPENDIX H: NOTICE OF AVAILABILITY FOR PUBLIC REVIEW, PROOF OF DELIVERY/PUBLICATION, COMMENTS RECEIVED ON FINAL DRAFT, AND RESPONSES

LIST OF FIGURES

FIGURE 1-1. REGIONAL LOCATION OF VAFB 4
FIGURE 1-2. PROPOSED PROJECT AREA AND VICINITY 5
FIGURE 2-1. PROPOSED CONCRETE LANDING PAD AND NEW ROAD 12
FIGURE 2-2. STAGES OF BOOST-BACK AND PROPULSIVE LANDING 15
FIGURE 2-3. TRAJECTORIES FOR THE FIRST STAGE RETURN PATH (GREEN LINE) AND SECOND STAGE PATH (YELLOW LINE) OF THE FALCON 9 FOR A LANDING AT SLC-4W ON VAFB 16
FIGURE 2-4. REGIONAL SONIC BOOM DISTRIBUTION AND INTENSITY FOR PAD LANDING AT SLC-4W WITH AN INCOMING TRAJECTORY FOR A LIGHT PAYLOAD ON VAFB 17
FIGURE 2-5. REGIONAL SONIC BOOM DISTRIBUTION AND INTENSITY FOR PAD LANDING AT SLC-4W WITH AN INCOMING TRAJECTORY FOR A HEAVY PAYLOAD ON VAFB 18
FIGURE 2-6. REGIONAL LANDING NOISE INTENSITY MAP FOR PAD LANDING AT SLC-4 ON VAFB 19
FIGURE 2-7. TRAJECTORIES FOR VARIATIONS OF THE CONTINGENCY FIRST STAGE RETURN PATH TO A DRONE SHIP LANDING LOCATION 31 MI. (50 KM) OFF OF VAFB (BLUE LINES) AND SECOND STAGE PATH (YELLOW LINE) 20
FIGURE 2-8. DRONE SHIP LANDING PLATFORM 21
FIGURE 2-9. HYPOTHETICAL SONIC BOOM OVERPRESSURE FOR CONTINGENCY ACTION OF DRONE SHIP LANDING 31 MI. (50 KM) OFFSHORE OF VAFB WITH AN INCOMING TRAJECTORY FOR A LIGHT PAYLOAD 23
FIGURE 2-10. HYPOTHETICAL SONIC BOOM OVERPRESSURE FOR CONTINGENCY ACTION OF DRONE SHIP LANDING 31 MI. (50 KM) OFFSHORE OF VAFB WITH AN INCOMING TRAJECTORY FOR A HEAVY PAYLOAD 24
FIGURE 2-11. APPROXIMATE REGIONAL LANDING NOISE INTENSITY MAP FOR CONTINGENCY ACTION DRONE SHIP LANDING 31 MI. (50 KM) OFF OF VAFB 25
FIGURE 2-12. DRONE SHIP LANDING ATTEMPT 27
FIGURE 2-13. DRONE SHIP LANDING PLATFORM AFTER AN UNSUCCESSFUL LANDING ATTEMPT 27
FIGURE 2-14. ESTIMATED EXPLOSION BLAST NOISE INTENSITY MAP FOR AN UNSUCCESSFUL DRONE SHIP LANDING 31 MI. (50 KM) OFF VAFB 29
FIGURE 2-15. ALTERNATIVE 2 AND NO ACTION ALTERNATIVE LANDING LOCATIONS 40
FIGURE 3-1. A AND C WEIGHTING SCALES 51
FIGURE 3-2. RELATIONSHIP OF SOUND LEVEL, L_{EQ}, AND DAY-NIGHT AVERAGE SOUND LEVEL 53
FIGURE 3-3. HABITAT TYPES AND SPECIAL STATUS SPECIES WITHIN THE PROJECT AREA 59
FIGURE 3-4. CRLF LOCALITIES ON VAFB AND SONIC BOOM INTENSITY 68
FIGURE 3-5. BOOST-BACK ENGINE LANDING NOISE CONTOURS GENERATED BY A SAMPLE TRAJECTORY 69
FIGURE 3-6. CURRENT LETE AND SNPL NESTING LOCALITIES AND SONIC BOOM INTENSITY 71
FIGURE 3-7. SOUTHERN SEA OTTER DISTRIBUTION AND SONIC BOOM INTENSITY 83
FIGURE 3-8. MARINE MAMMAL HAUL-OUT SITES ON WITHIN THE REGION OF EXPECTED LANDING NOISE FOR SLC-4W LANDING 85
FIGURE 3-9. MARINE MAMMAL HAULOUTS ON VAFB AND EXPECTED SONIC BOOM LEVELS FOR SLC-4W LANDING 86
FIGURE 3-10. MARINE MAMMAL HAUL OUTS ON VAFB AND EXPECTED SONIC BOOM LEVELS FOR SLC-4W LANDING 87
FIGURE 3-11. ESSENTIAL FISH HABITAT WITHIN THE PROJECT AREA 100
FIGURE 3-12. LEATHERBACK SEA TURTLE CRITICAL HABITAT 101
FIGURE 3-13. MARINE RESERVES AND MARINE CONSERVATION AREAS IMPACTED BY SONIC BOOM AS A RESULT OF FALCON 9 BOOST-BACK AND LANDING AT SLC-4W 102
FIGURE 3-14. MARINE RESERVES AND MARINE CONSERVATION AREAS IMPACTED BY SONIC BOOM AS A RESULT OF FALCON 9 BOOST-BACK AND LANDING AT THE CONTINGENCY LANDING LOCATION 103
FIGURE 3-15. ERP SITES AT SLC-4W 115
FIGURE 3-16. LAND USE AND AESTHETICS AROUND SLC-4W ON VAFB 118
FIGURE 3-17. MAIN ACCESS AND TRANSPORTATION ROUTES ASSOCIATED WITH THE PROPOSED ACTION 122
FIGURE 4-1. SONIC BOOM SPECTRUM AND SEA OTTER HEARING SENSITIVITY CURVE 157
FIGURE 4-2. EVAPORATION RATE OF JET A1 FUEL (SIMILAR TO RP-1) AS FUNCTION OF TIME (MINUTES) 164

LIST OF TABLES

TABLE 2-1. ESTIMATED EQUIPMENT USAGE UNDER THE PROPOSED ACTION 13
TABLE 3-1. AMBIENT AIR QUALITY STANDARDS 46
TABLE 3-2. BACKGROUND AMBIENT AIR QUALITY AT VAFB (CONCENTRATIONS IN PPM UNLESS OTHERWISE INDICATED) 48
TABLE 3-3. SOUND LEVELS OF SELECTED SOUND SOURCES AND ENVIRONMENTS 54
TABLE 3-4. FEDERAL AND STATE SPECIAL STATUS PLANT SPECIES WITH POTENTIAL TO OCCUR IN THE VICINITY OF THE PROPOSED CONSTRUCTION AREA AND SENSITIVE PLANT COMMUNITIES OCCURRING WITHIN THE CONSTRUCTION AREA 59
TABLE 3-5. SPECIAL STATUS SPECIES OCCURRING OR POTENTIALLY OCCURRING WITHIN THE TERRESTRIAL PORTION OF THE PROJECT AREA 63
TABLE 3-6. SPECIAL-STATUS NON-MAMMAL SPECIES WITHIN THE ROI FOR THE PROPOSED ACTION 73
TABLE 3-7. STATUS OF PROTECTED MARINE MAMMAL SPECIES POTENTIALLY OFFSHORE AND WITHIN THE CONTINGENCY LANDING AREA OF EFFECT 75
TABLE 3-8. LEVEL OF SERVICE SCALE 121
TABLE 4-1. ESTIMATED EQUIPMENT USAGE UNDER THE PROPOSED ACTION 128
TABLE 4-2. PROPOSED ACTION CONSTRUCTION EMISSIONS (TONS/YEAR) 129
TABLE 4-3. PROPOSED ACTION OPERATIONAL EMISSIONS (TONS/YEAR) 131
TABLE 4-4. PROPOSED ACTION VESSEL EMISSIONS FOR THE CONTINGENCY DRONE SHIP LANDING WITHIN AND BEYOND CALIFORNIA COASTAL WATERS (TONS/YEAR) 132
TABLE 4-5. SUMMARY OF ANNUAL AIR EMISSION FOR THE PROPOSED ACTION (TONS/YEAR) 133
TABLE 4-6. PROPOSED ACTION GHG EMISSIONS 136
TABLE 4-7. TYPICAL CONSTRUCTION NOISE LEVELS 138
TABLE 4-8. POTENTIAL IMPACTS TO SPECIAL STATUS WILDLIFE WITHIN THE TERRESTRIAL PORTION OF THE PROPOSED ACTION AREA 146
TABLE 4-9. NOAA FISHERIES INTERIM SOUND THRESHOLD GUIDANCE[1] 152
TABLE 4-10. NOAA FISHERIES SOUND THRESHOLD GUIDANCE FOR IN-WATER EXPLOSIVES[1] 153
TABLE 4-11. ESTIMATED AT-SEA DENSITY OF INDIVIDUALS PER KM^2, PROBABILITY OF DIRECT IMPACT OF ROCKET DEBRIS PER EVENT, AND ESTIMATED NUMBER OF TAKES 159
TABLE 4-12. POTENTIAL IMPACTS TO MARINE MAMMAL SPECIES POTENTIALLY OCCURRING WITHIN THE CONTINGENCY AREA 165
TABLE 4-13. ESTIMATED AT-SEA DENSITY OF INDIVIDUALS PER KM^2, PROBABILITY OF DIRECT IMPACT OF ROCKET DEBRIS PER EVENT, AND ESTIMATED NUMBER OF TAKES 167
TABLE 4-14. SEA TURTLE IMPACT THRESHOLD CRITERIA FOR IMPULSIVE SOURCES 168
TABLE 4-15. ESTIMATED EXPLOSIVE EFFECTS RANGES FOR FISH WITH SWIM BLADDERS 171
TABLE 4-16. POTENTIAL IMPACTS TO SPECIAL STATUS NON-MAMMAL SPECIES POTENTIALLY OCCURRING WITHIN THE CONTINGENCY AREA 173
TABLE 4-17. FEDERAL AND NON-FEDERAL PROJECTS 194

ACRONYMS AND ABBREVIATIONS

˚	degree(s)
˚C	degree(s) Centigrade
˚F	degree(s) Fahrenheit
µg/m3	milligram(s) per cubic meter
30 CES/CEI	30th Space Wing, Installation Management Flight
30 CES/CEIEA	30th Space Wing, Installation Management Flight, Environmental Conservation
30 CES/CEIEC	30th Space Wing, Installation Management Flight, Environmental Quality
30 CES/CEIOP	30th Space Wing, Installation Management Flight, Comprehensive Planning
30 SW/SE	30th Space Wing, Office of the Chief of Safety
30 SW	30th Space Wing
30 SW/SEL	30th Space Wing Launch Safety
30 SW/SEW	30th Space Wing, Weapons Safety Office
30 SWI	30th Space Wing Instruction
30 SWP	30th Space Wing Plan
ac.	acre(s)
ADT	Average Daily Traffic
AFCEC/CZO	Air Force Civil Engineering Center, Environmental Center for Excellence Operations
AFI	Air Force Instruction
AFOSH	Air Force Occupational Safety and Health
AFSPC	Air Force Space Command
AFSS	Autonomous Flight Safety System
AICUZ	Air Installation Compatible Use Zone
AGL	above ground level
APZ	Accident Potential Zone
Base	Vandenberg Air Force Base
BCC	Federal Bird Species of Conservation Concern
BGEPA	Bald and Golden Eagle Protection Act
BIA	Biologically Important Area
BMP	Best Management Practice
BO	Biological Opinion
BP	Before Present
C&D	construction and demolition
CA	California
CAA	Clean Air Act
CAAA	Clean Air Act Amendments
CAAQS	California Ambient Air Quality Standards
Cal/OSHA	California Division of Occupational Safety and Health
CARB	California Air Resources Board
CASQA	California Stormwater Quality Association
CCA	California Coastal Act
CCC	California Coastal Commission
CCS	central coast scrub
CD	Consistency Determination
CDFW	California Department of Fish and Wildlife
CEQ	Council on Environmental Quality
CEQA	California Environmental Quality Act
CESA	California Endangered Species Act
CetMap	Cetacean Density and Distribution Mapping Working Group
C.F.R	Code of Federal Regulations
CH_4	methane
CINMS	Channel Islands National Marine Sanctuary
CNDDB	California Natural Diversity Database
CNPS	California Native Plant Society
CO	carbon monoxide
CO_2	carbon dioxide
CO_2e	carbon dioxide equivalent
COC	contaminants of concern
COI	Certificate of Inspection
COPV	Carbon Over Pressure Vessel
CSC	California Species of Special Concern
CRLF	California red-legged frog
CSE	Comprehensive Site Evaluation
CWA	Clean Water Act
CZMA	Coastal Zone Management Act
dB	decibel(s)
dBA	A-weighted decibel(s)
dBP	unweighted decibel(s)
dB re µPa	decibel(s) referenced to micropascal(s)
DMM	Discarded Military Munitions
DNL	Day-Night Average Sound Level
DoD	Department of Defense
DOT	Department of Transportation
DPE	dual phase extraction
DPS	Distinct Population Segment
EA	Environmental Assessment

EELV	Evolved Expendable Launch Vehicle
EFH	Essential Fish Habitat
EIAP	Environmental Impact Analysis Process
EIS	Environmental Impact Statement
EMS	Environmental Management System
ENVIRON	ENVIRON International Corporation
EO	Executive Order
EOD	Explosive Ordnance Disposal
EPM	Environmental Protection Measure
ERP	Environmental Restoration Program
ESA	Endangered Species Act
ESBB	El Segundo blue butterfly
FAA	Federal Aviation Administration
FE	federally endangered
FFDP	Final Flight Data Package
FONPA	Finding of No Practicable Alternative
FONSI	Finding of No Significant Impact
FP	California Fully Protected Species
FR	Federal Register
FSDP	Flight Safety Data Plan
ft.	foot/feet
$ft.^2$	square foot/feet
FT	federally threatened
FTS	Flight Termination System
GHG	greenhouse gas
GPS	Global Positioning System
GSE	ground support equipment
GVWR	gross vehicle weight rating
GWP	global warming potential
HAPC	Habitat Area of Particular Concern
HFC	hydroflourocarbon
HS	hydrogen sulfide
Hwy	Highway
Hz	Hertz
IICEP	Interagency and Intergovernmental Coordination for Environmental Planning
IHA	Incidental Harassment Authorization
INRMP	Integrated Natural Resources Management Plan
IRP	Installation Restoration Program
ITLO	Installation Tribal Liaison Officer
kHz	kilohertz
km	kilometer(s)
km^2	square kilometer(s)
lb.	pound(s)
LCZ	Lateral Clear Zone
L_{eq}	single equivalent sound level
L_{eq1H}	the continuous sound level that would contain the same acoustical energy for 1 hour as the fluctuating sound levels during the same period
LETE	California least tern
LLC	Launch and Landing Control
LOS	Level of Service
LOX	liquid oxygen
m	meter(s)
m^2	square meter(s)
m^3	cubic meter(s)
MBTA	Migratory Bird Treaty Act
MC	munitions constituents
MD	munitions debris
MEC	munitions and explosives of concern
mi.	mile(s)
MMPA	Marine Mammal Protection Act
MMRP	Military Munitions Response Program
mph	miles per hour
MSA	Magnuson-Stevens Fishery Conservation and Management Act
N	north
N_2	nitrogen
N_2O	nitrous oxide
NAAQS	National Ambient Air Quality Standards
NASA	National Aeronautics and Space Administration
NCA	Noise Control Act
ND	Negative Determination
NEPA	National Environmental Policy Act
NHPA	National Historic Preservation Act
nm	nautical mile(s)
NNG	non-native grassland
NOAA Fisheries	National Oceanic and Atmospheric Administration, National Marine Fisheries Service
NO_2	nitrogen dioxide
NO_x	nitrogen oxide
NPDES	National Pollutant Discharge Elimination System
NRHP	National Register of Historic Places
NSR	New Source Review
O_3	ozone
OEEL	Occupational and Environmental Exposure Limit

OSHA	Occupational Safety and Health Administration
oz.	ounce(s)
P2	pollution prevention
PAH	polycyclic aromatic hydrocarbon
Pb	lead
PCB	polychlorinated biphenyl
PERP	Portable Equipment Registration Program
PFC	perfluorocarbon
PL	Public Law
$PM_{2.5}$	particulate matter less than 2.5 microns
PM_{10}	particulate matter less than 10 microns
PPA	Pollution Prevention Act
ppm	part(s) per million
psf	pound(s) per square foot
psi	pound(s) per square inch
PTS	Permanent Threshold Shift
RMS	Root Mean Squared
ROG	reactive organic gases
ROI	region of influence
RP-1	rocket propellant
RWQCB	Regional Water Quality Control Board
SAA	Space Act Agreement
SBCAPCD	Santa Barbara County Air Pollution Control District
SC	State Candidate Species
SCCAB	South Central Coast Air Basin
SE	State Endangered Species
SEL	Sound Exposure Level
SHPO	State Historic Preservation Office
SIP	State Implementation Plan
SF_6	sulfur hexafluoride
SLC	Space Launch Complex
SLC-4E	Space Launch Complex 4 East
SLC-4W	Space Launch Complex 4 West
SNPL	western snowy plover
SO_2	sulfur dioxide
SpaceX	Space Exploration Technologies Corporation
SR	State Route
SSPP	Strategic Sustainability and Performance Plan
SWPPP	Storm Water Pollution Prevention Plan
SWRCB	State Water Resources Control Board
SYBCI	Santa Ynez Band of Chumash Indians
TCE	trichloroethylene
TCH	toxic hazard corridors
TNT	trinitrotoluene
TTS	Temporary Threshold Shift
UPRR	Union Pacific Railroad
U.S.	United States
U.S.C.	United States Code
USGS	U.S. Geological Survey
USAF	United States Air Force
USEPA	United States Environmental Protection Agency
USFWS	United States Fish and Wildlife Service
UXO	unexploded ordnance
VAFB	Vandenberg Air Force Base
V/C	volume-to-capacity
VOC	volatile organic compounds
VSMR	Vandenberg State Marine Reserve
W	west

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1 Purpose of and Need for the Proposed Action

This Environmental Assessment (EA) evaluates the potential environmental impacts associated with the boost-back and vertical landing of the Falcon 9 Full Thrust First Stage booster at Space Launch Complex 4 West (SLC-4W) on Vandenberg Air Force Base (VAFB or Base), California or on a special purpose barge (hereafter referred to as an autonomous drone ship or drone ship), no less than 31 miles [mi] (50 kilometers [km]) off VAFB's shore. This EA also addressed related infrastructure improvements at SLC-4W and implementation of the Autonomous Flight Safety System (AFSS). Space Exploration Technologies Corporation (SpaceX) is currently operating the Falcon Launch Vehicle Program at Space Launch Complex 4 East (SLC-4E) on VAFB. SpaceX proposes regular employment of stage recovery (boost-back and landing) by returning the Falcon 9 Full Thrust First Stage to SLC-4W or another SpaceX launch facility for potential reuse approximately six times per year. Per agreements between the United States (U.S.) Air Force (USAF) and the Federal Aviation Administration (FAA), the USAF will act as the lead agency for the preparation and coordination of the National Environmental Policy Act (NEPA) documentation for the Proposed Action, and the FAA will act as a cooperating agency.

To ensure that launch services provided by private enterprises are consistent with national security and foreign policy interests of the United States and do not jeopardize public safety and the safety of property, the Commercial Space Launch Act of 2011 (51 United States Code [U.S.C.] Subtitle V, Chapter 509, Sections 50901-50923) authorizes the Department of Transportation (DOT) to license and regulate U.S. commercial launch activities. Within the DOT, the Secretary of Transportation's authority under the Commercial Space Launch Act has been delegated to the FAA Office of Commercial Space Transportation. Therefore, the FAA is a cooperating agency in reviewing the preparation of this EA.

The National Aeronautical and Space Administration (NASA) provides special expertise with respect to potential environmental impacts from space launches and the operation of a launch site. NASA also has special expertise and interest in the operation of reusable suborbital rockets through its programs, which are intended to help foster the development of the commercial reusable suborbital transportation industry. Additionally, NASA uses Space Act Agreements and contracts, as well as competitions, to promote technology development and demonstration. NASA's partnerships with commercial suppliers and private enterprises are expanding such that NASA may have a direct or indirect contribution to a commercial payload. For these reasons, NASA is also a cooperating agency in the development of this EA.

This EA has been prepared per the NEPA of 1969 (42 U.S.C. §4321 et seq.), the Council on Environmental Quality's (CEQ's) Regulations for Implementing the Procedural Provisions of NEPA (40 Code of Federal Regulations [C.F.R.] 1500-1508), the USAF's Environmental Impact Analysis Process (EIAP) (32 C.F.R. 989), and FAA Order 1050.1F, *Environmental Impacts: Policies and Procedures*.

1.1 Background

The Commercial Space Launch Act of 2011 (Public Law 98-575), declares that the development of commercial launch vehicles and associated services is in the national economic interest of the United States. The Commercial Space Launch Act also allows government infrastructure and resources currently underutilized to be used as excess capacity to promote commercial investment and use of space. The USAF provides support to the U.S. Government and commercial entities for low-cost and reliable access to space.

The United States has recognized that space transportation costs must be significantly reduced to make continued exploration, development, and use of space more affordable. The National Space Policy of 28 June 2010 (U.S. Government 2010) includes as one of its principles a commitment to "encouraging and facilitating the growth of a U.S. commercial space sector that supports U.S. needs, is globally competitive, and advances U.S. leadership in the generation of new markets and innovation-driven entrepreneurship." The National Space Policy provides its following guidelines (in part):

- Encourage an innovative and entrepreneurial commercial space sector.
- Enhance operational efficiency, increase capacity, and reduce launch costs by investing in the modernization for space launch infrastructure.
- Develop launch systems and technologies necessary to assure and sustain future reliable and efficient access to space, in cooperation with U.S. industry, when sufficient U.S. commercial capabilities and services do not exist.
- Purchase and use commercial space capabilities and services to the maximum practical extent when such capabilities and services are available in the marketplace and meet U.S. Government requirements.

1.2 Purpose and Need

The purpose of the Proposed Action is to substantially reduce the cost to the government of reliable U.S. enterprise access to space through the reuse of the Falcon 9 Full Thrust First Stage booster and implementation of the AFSS, thus complying with the National Space Policy. The purpose of the Proposed Action is also to fulfill the FAA's responsibilities as authorized by Executive Order (EO) 12465, *Commercial Expendable Launch Vehicle Activities*, and the Commercial Space Launch Act for oversight of commercial space launch activities. The FAA expects to receive a license application from SpaceX that could include Falcon 9 Full Thrust First Stage boost-back and landing at VAFB. The FAA would be required to review the application and determine whether to issue a license. The action continues to fulfill the U.S. expectation that space transportation costs are reduced to make continued exploration, development, and the use of space more affordable.

The reuse of the Falcon 9 Full Thrust First Stage would enable SpaceX to efficiently conduct lower cost launch missions from VAFB in support of commercial and government clients. The need for the Proposed Action results from the statutory direction from Congress under the Commercial Space Launch Act to protect the public health and safety, safety of property, and national security and foreign policy interests of the U.S. and to encourage, facilitate, and promote commercial

space launch and reentry activities by the private sector to strengthen and expand U.S. space transportation infrastructure during commercial launch or reentry activities.

Implementation of the AFSS would reduce overall costs as well by reducing the number of engineering and support hours through automation. It also reduces infrastructure and the associated costs of operating and maintaining it.

The Proposed Action is needed so that SpaceX can implement missions for the USAF and NASA (under the Space Act Agreement [SAA]). In addition, the Proposed Action supports VAFB's vision of becoming the "world's most innovative space launch and landing team" (U.S. Air Force 2014a). The contingency action is necessary to provide for an alternative landing location if the Western Range deems that the first stage overflight of south VAFB is unacceptable due to potential impacts to critical assets or weather conditions or mission parameters do not permit for a successful landing attempt. In this case, the First Stage would be landed on an autonomous drone ship, no less than 31 mi. (50 km) offshore of VAFB. The contingency landing location is the furthest location from the coastline that SpaceX is able to place the landed first stage within landing mission parameters. A contingency landing location further from the coastline would increase forces on the rocket due to an increased angle of return trajectory, which could lead to a structural failure of the vehicle. A contingency autonomous drone ship landing is possible several hundred miles offshore downrange, however landing offshore of VAFB requires the least amount of distance from the launch location to avoid diverting from the primary mission trajectory. Since Range conditions could change up until the day of launch it is important to maintain a seamless alternative to landing at SLC-4W that does not drastically change the primary mission trajectory.

1.3 Project Location

VAFB occupies approximately 99,100 acres (ac.) (400 square kilometers [km^2]) of central Santa Barbara County, California (Figure 1-1), approximately halfway between San Diego and San Francisco. The Vandenberg Air Force Base (Base) occurs in a transitional ecological region that includes the northern and southern distributional limits for many plant and animal species. The Santa Ynez River and State Highway 246 divide VAFB into two distinct parts: North Base and South Base. SLC-4W is located on South Base, approximately 0.5 mi. (0.8 km) inland from the Pacific Ocean (Figure 1-2). SLC-4E is the launch facility for the Falcon 9 program, which is located approximately 715 feet (ft.) (218 meters [m]) to the east of SLC-4W, the proposed landing site for the Falcon 9 Full Thrust First Stage (Figure 1-2, inset). The contingency landing location is located 31 mi. (50 km) offshore of VAFB (Figure 2-9).

The 30th Space Wing (30 SW) at VAFB is the USAF Space Command organization responsible for Department of Defense (DoD) space and missile launch activities on the west coast of the United States. Satellites destined for polar or near-polar orbit are launched from VAFB, and ballistic missiles are tested. The wing supports West Coast launch activities for the USAF, DoD, Missile Defense Agency, NASA, foreign nations, and various private industry contractors, including SpaceX.

Figure 1-1. Regional Location of VAFB

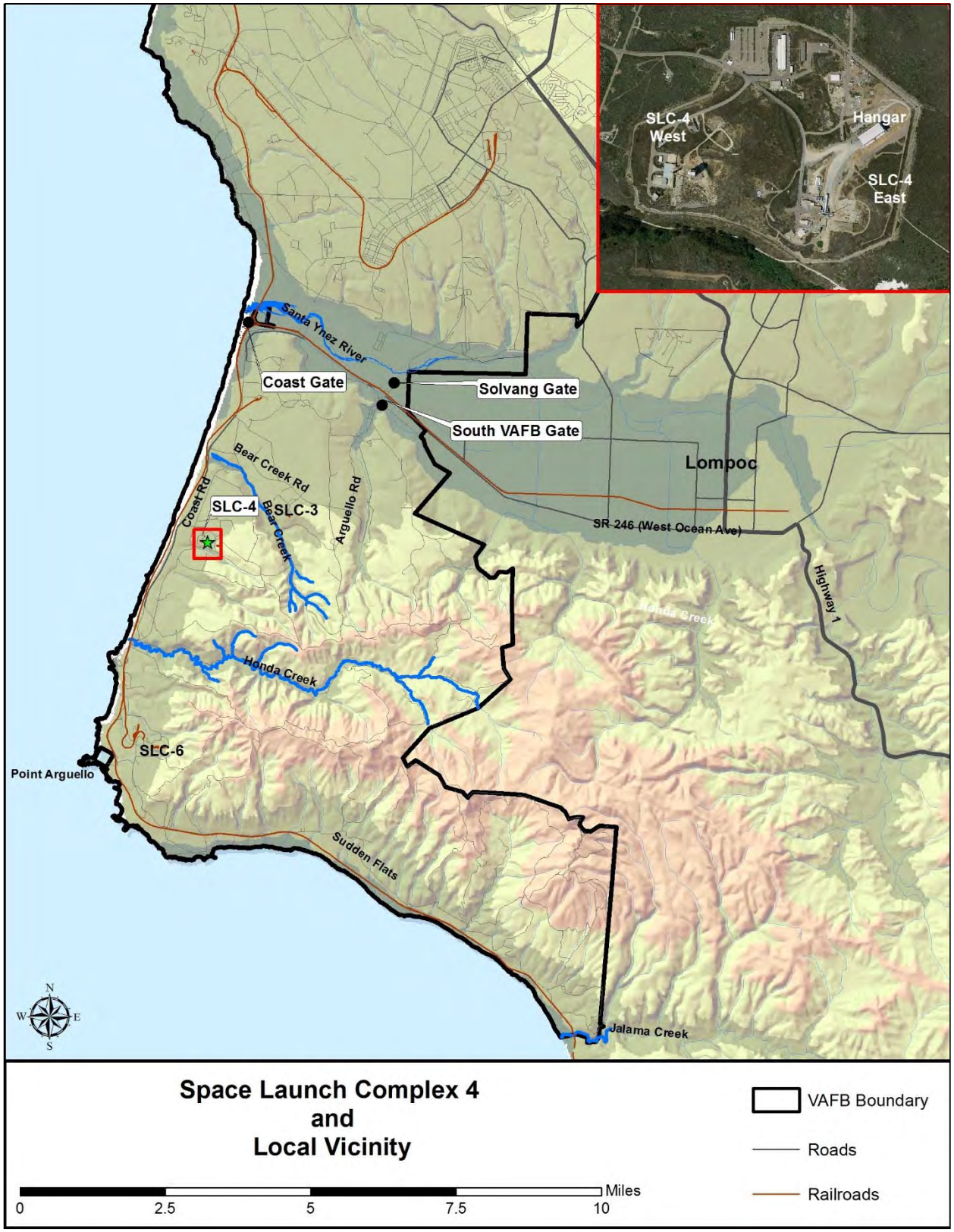

Figure 1-2. Proposed Project Area and Vicinity

1.4 Scope of the Environmental Assessment

This EA identifies, describes and evaluates the potential environmental impacts that could result from the Proposed Action, reasonable alternatives to the Proposed Action, and the No-Action Alternative, as well as possible cumulative impacts from other past, present and reasonably foreseeable actions on VAFB. The EA identifies environmental permits relevant to the Proposed Action. The EA describes, in terms of a regional overview or a site-specific description, the affected environment and environmental consequences of the action. Finally, the EA identifies management measures to avoid, prevent, or minimize environmental impacts.

The scope of this EA is limited to the boost-back and landing of the first stage of a Falcon 9 Full Thrust vehicle at SLC-4W and the contingency offshore location, and the alternative described in Chapter 2 (Description of the Proposed Action and Alternatives). Launch activities and potential environmental impacts were previously analyzed in the 2011 EA for Falcon 9 and Falcon 9 Heavy Launch Vehicle Programs from SLC-4E on VAFB (U.S. Air Force 2011a). This EA does not include a multiple booster landing scenario or boost-back and landing of a Falcon Heavy single first stage, as it was included in the Falcon 9 launch program.

1.5 Interagency Coordination and Consultation

The USAF implements a process known as Interagency and Intergovernmental Coordination for Environmental Planning (IICEP), which is used for the purpose of agency coordination and implements scoping requirements. Through the IICEP process, VAFB notified relevant federal, state, and local agencies, and the surrounding communities of the Proposed Action, and provided them sufficient time to make known their environmental concerns specific to the action (Appendix A).

Under the Coastal Zone Management Act (CZMA) of 1972 (16 U.S.C. 2452-24645), a federal action that may affect the coastal zone must be carried out in a manner that is consistent with state coastal zone management programs. VAFB determined that the Proposed Action would not adversely affect coastal zone resources, and the California Coastal Commission (CCC) concurred with a Negative Determination (ND) on 13 October 2014 for modifications to SLC-4W and a one-time Falcon 9 Full Thrust First Stage boost-back and landing at SLC-4W, and a ND on 31 August 2015 for recurring boost-back and landing of the Falcon 9 Full Thrust First Stage at SLC-4W and on a drone ship at least 31 mi. (50 km) offshore of VAFB, pursuant to 15 C.F.R. 930.35 of the National Oceanic and Atmospheric Administration (NOAA) implementing regulations (Appendix B).

If, after reviewing the EA, the FAA determines the Proposed Action would not individually or cumulatively result in significant impacts on the human environment, the FAA would issue its own Finding of No Significant Impact (FONSI) to support issuing a reentry license to SpaceX. The FAA will draw its own conclusions from the analysis presented in this EA and assume responsibility for its environmental decisions and any related mitigation measures. For the FAA to use this analysis to support its determination, the EA must meet the requirements of FAA Order 1050.1F, *Environmental Impacts: Policies and Procedures*, which contains the FAA's policies and procedures for compliance with NEPA.

The Proposed Action is a federal undertaking subject to compliance with Section 106 of the National Historic Preservation Act (NHPA) of 1966 as amended (16 U.S.C. 470 et seq.). VAFB initiated consultation with the State Historic Preservation Officer (SHPO) under 36 C.F.R. Part 800. VAFB determined that the Proposed Action would have no adverse effect to any properties listed in or potentially listed in the National Register of Historic Places. The SHPO has concurred with VAFB's determination of no adverse effect to historic properties (Appendix C). Native American traditional cultural properties are also protected by the NHPA of 1966, as amended (16 U.S.C. 470). EO 13175, *Consultation and Coordination with Indian Tribal Governments*, directs Federal agencies to coordinate and consult with Native American tribal governments whose interests might be directly and substantially affected by activities on federally administered lands. Consultation with the Santa Ynez Band of the Chumash Indians is discussed below in Section 1.6 (Intergovernmental Coordination and Consultation).

Under Section 7 of the Endangered Species Act (ESA) of 1973, as amended (16 U.S.C. 1531 et seq.), federal agencies are required to assess the effect of projects authorized, funded by, or carried out by federal agencies on federally listed threatened or endangered species. Section 7 consultations with the U.S. Fish and Wildlife Service (USFWS) and NOAA National Marine Fisheries Service (NOAA Fisheries) are required for federal projects if such actions have the potential to directly or indirectly affect listed species or destroy or adversely modify critical habitat. VAFB initiated formal Section 7 consultations with the USFWS to address potential adverse impacts to federally protected species, associated with the construction of the landing pad at SLC-4W. The completed consultation was in the form of a Biological Opinion ([BO] 8-8-14-F-41 [Appendix D]) issued by the USFWS. VAFB also completed informal consultation with the USFWS (2015-I-0208; Appendix D) and informal consultations with NOAA Fisheries (Appendix E) for non-adverse impacts to federally protected wildlife species associated with the boost-back and landing of the Falcon 9 Full Thrust First Stage.

1.6 Intergovernmental Coordination and Consultation

Native American traditional cultural properties are protected by the NHPA of 1966, as amended (16 U.S.C. 470). Traditional cultural properties are eligible for listing in the National Register of Historic Places because of their association with cultural practices or beliefs of a living community that (1) are rooted in that community's history, and (2) are important in maintaining and continuing cultural identity of the community. Traditional cultural properties may be identified by Native Americans or other living communities. Even if resources that are significant to Native American Tribes may not be considered traditional cultural properties, these resources may be afforded protection by other laws, regulations, or EOs.

Section 106 of the NHPA requires federal agencies to consider the effects of their actions on cultural resources listed in or eligible for inclusion in the National Register. The regulations implementing Section 106 (36 C.F.R. §800) specify a consultation process to assist in satisfying this requirement. The 30 SW Commander appointed Christopher Ryan (30th Space Wing, Installation Management Flight, Environmental Conservation [30 CES/CEIEA]) as the Installation Tribal Liaison Officer (ITLO). Mr. Ryan carried out American Indian consultation with Sam Cohen of the Santa Ynez Band of Chumash Indians (SYBCI), who is the tribal chairman's appointee to VAFB for Section 106 consultations, and Mr. Freddie Romero, who is the elder's council appointee

for Section 106 consultations. As the SYBCI is a federally recognized tribe, this also constitutes government-to-government consultation. The SYBCI was notified of the Proposed Action in an e-mail dated 14 October 2014 requesting tribal comments on the Proposed Action and initiating government-to-government consultation (Appendix F). The SYBCI responded on 28 July 2015, indicating that there were no concerns with the Proposed Action (Appendix F).

2 Description of the Proposed Action and Alternatives

This chapter provides detailed descriptions of the Proposed Action (Alternative 1), Alternative 2 for landing the First Stage on a drone ship in the Pacific Ocean, and the No Action Alternative. Chapter 2 also describes selection criteria used to identify and select alternatives and summarizes alternatives that were considered but eliminated from further analysis.

2.1 Introduction

SpaceX is currently operating the Falcon Launch Vehicle Program at SLC-4E. The 2011 EA included First Stage recovery by parachute into the Pacific Ocean between 300 and 500 mi. (482 and 804 km) west of the California coast (in all launch azimuth directions from VAFB). Modifications to SLC-4W to support landing was not included as part of the analyzed action. SLC-4W was previously used for Titan II launches until this site was officially decommissioned in 2006 after the last Titan IV rocket along with the Titan IV program on SLC 4E. This EA covers the Falcon 9 boost-back and landing and Contingency Action, not previously analyzed in past EAs.

The Falcon 9 Full Thrust First Stage is 12 ft. (3.7 m) in diameter and 160 ft. (49 m) in height, including the interstage that would be attached during landing. The First Stage includes nine Merlin engines with a total lift off thrust of approximately 1.53 million pounds (lb.) and consists of aluminum liquid oxygen (LOX) and rocket propellant (RP-1) tanks that hold approximately 662,250 lb. of LOX and 260,760 lb. of RP-1. The First Stage currently drops into the Pacific Ocean approximately 300–500 mi. (480–800 km) west of the Baja California coast and is non-recoverable.

2.2 Selection Criteria

A range of reasonable alternatives were identified at VAFB by evaluating the ability of each alternative to meet the purpose and need of the Proposed Action and their ability to meet the following selection criteria:

- Criterion 1: Landing location within fence line and with controlled access or at contingency landing location in Pacific Ocean if necessary;
- Criterion 2: Contingency landing locations as far from the coastline as possible while maintaining the same boost-back trajectory as for a land landing at SLC-4W.
- Criterion 3: No conflicting or current or future land use has been declared for the VAFB landing site;
- Criterion 4: Recovery and processing of the Falcon 9 Full Thrust First Stage after landing would occur with minimum disturbance to VAFB operations;
- Criterion 5: VAFB landing location with existing water, electrical, and communication infrastructure required for a landing site to minimize the need for new construction and meet timeline goals for implementation;
- Criterion 6: Ability to utilize an existing commercial fiber connection to run video feeds and post-landing communication of the First Stage to mission control, which avoids constructing a new fiber connection to another location on VAFB;

- Criterion 7: VAFB landing location that can accommodate the required 300 ft. diameter landing pad area;
- Criterion 8: VAFB landing location close enough to the launch site to support a timely processing of the recovered First Stage for subsequent launches; and
- Criterion 9: Minimization of potential negative effects to the environment, including a VAFB landing location that would require minimal impacts to previously undisturbed land and activities that would minimize potential effects to sensitive resources.

In addition, *CEQ Regulations for Implementing the Procedural Provisions of NEPA* require federal agencies to use the NEPA process to identify and assess the reasonable alternatives to the Proposed Action that would avoid or minimize adverse effects of those actions on the quality of the human environment. A number of alternatives were originally considered but dismissed from detailed analysis in this EA as they were not considered reasonable. The Proposed Action and one action alternative, landing the First Stage on a drone ship, were the only alternatives that were carried forward for further evaluation because these alternatives best met the purpose and need while meeting the screening criteria. One feasible alternative was identified for consideration but eliminated (see Section 2.6, Other Alternatives Considered and Eliminated from Further Analysis).

2.3 Alternative 1 (Proposed Action)

Alternative 1 includes: infrastructure improvements at SLC-4W; the boost-back maneuver (in-air) and landing of the Falcon 9 Full Thrust First Stage on the new pad at SLC-4W; the boost-back and landing of the Falcon 9 Full Thrust First Stage on a drone ship specifically designed for the landing and located at least 31 mi. (50 km) offshore of VAFB; and implementation of an autonomous flight termination system for Falcon 9 launch and boost-back.

Alternative 1 meets all of the selection criteria and has been selected as the Proposed Action for the following reasons:

- SLC-4W was previously used as a launch complex facility; the area is fenced with controlled access (Criterion 1).
- The contingency landing location is the furthest from the coastline that SpaceX is able to place the landed stage and maintain the same boost-back trajectory as for a land landing at SLC-4W (Criterion 2).
- Use of SLC-4W is compatible with current and future land use plans (Criterion 3).
- SLC-4W offers an area removed from most current VAFB operations; recovery and processing of the First Stage after landing would occur with minimum disturbance to VAFB operations (Criterion 4).
- SLC-4W contains existing water, electrical, communication infrastructure (Criterion 5)
- SLC-4W has a commercial fiber connection (Criterion 6).
- SLC-4W can accommodate the required 200 x 200 ft. diameter landing pad area (Criterion 7).

- SLC-4W is adjacent to the launch pad at SLC-4E (Criterion 8), which will support a timely processing of the First Stage for subsequent launches. SLC-4W is a previously disturbed site (Criterion 9).

2.3.1 SLC-4W Infrastructure Improvements

SpaceX would construct up to a 300 ft. diameter concrete landing pad at SLC-4W (Figure 2-1). There is currently no flat area within SLC-4W that can support this configuration without site grading activities. Construction activities would require approximately 30 personnel onsite. Construction of the pad is anticipated to occur in April 2016; however, it may occur any time of year. Construction would require up to 45 days. Site grading is required to provide a flat compacted area to construct the concrete pad. Approximately 25,000 cubic yards (19,114 cubic meters [m^3]) of soil would be excavated. Any soil excavated at the project site would be redistributed on-site and not transported elsewhere.

The concrete for the new landing pad would be sourced from a combination of two contractors located in Lompoc and Nipomo, California. Approximately 153 truckloads of concrete would be delivered from Lompoc, California, and approximately 77 loads would be delivered from Nipomo, California. Each load would carry approximately 8 cubic yards (6.1 m^3) of concrete. Aggregate base would be applied under the concrete landing pad, requiring approximately 215 truckloads of P209 base delivered from Santa Ynez, California. Recycled ¾-inch aggregate base would be applied under the perimeter and approach roads, which require approximately 350 truckloads delivered from Buellton, California.

The pad would be constructed to control all runoff from the landing pad. A v-ditch surrounding the pad would convey storm water to the appropriate location as well as provide containment for potential spill or firefighting measures, including any water applied by the FireX system. In addition, all stormwater coming off the landing pad would be directed to an infiltration basin designed and sized according to the State Water Resources Control Board (SWRCB) Construction General Permit (WDID Number: 3 42W000312).

A FireX system would be constructed to control any fires that could be ignited during the Falcon 9 Full Thrust First Stage landing. The system would have 3 to 4 remote controlled water cannons (similar to SLC-4E) mounted on posts above ground to allow for remote firefighting capabilities. The existing underground water lines at SLC-4 are sufficient in size to support the FireX system. Trenching for new water lines to connect the FireX system to the existing water distribution system would be required.

The existing access road would be realigned, widened to approximately 40 ft. (12 m) and paved with asphalt, to support First Stage removal from the landing pad and ground support equipment (GSE) access to process the First Stage. Ground support equipment includes a 16 ft. flatbed trailer and a fuel truck to offload any remaining RP-1 from the First Stage.

Figure 2-1. Proposed Concrete Landing Pad and New Road

Construction of the pad and roadway improvements would result in approximately 56,000 square feet (ft.^{2}) (5,203 square meters [m^2]) of new impervious surface. Ground based communication, tracking, and video equipment is required and existing infrastructure at SLC-4W (existing conduits, camera stands, junction boxes) would be used to the greatest extent possible to reduce requirements for trenching. Further site design is required to determine exact locations of this infrastructure.

2.3.1.1 Project Equipment Needs and Site Access

The Proposed Action includes construction of the concrete landing pad at SLC-4W and improvements to existing access roads. Construction is anticipated to take 45 days. During an additional 45 to 75 days, concrete would be curing and minimal construction activities and noise would occur. Table 2-1 lists the equipment that would be used for construction of the project. Generators would be registered under California's Portable Equipment Registration Program (PERP). In areas where sensitive resources are noted by the 30th Space Wing, Installation Management Flight, Environmental Quality (30 CES/CEIEC), or 30 CES/CEIEA personnel, access would be either straight from a paved area or circuitously in a route that would avoid impacts.

Table 2-1. Estimated Equipment Usage under the Proposed Action

Equipment Description	Quantity	Make/Model or horsepower	Estimated Usage (days)*
Bulldozer	1	Caterpillar D-6	14
Excavator	1	Caterpillar 450	30
Vibratory drum compactor	1	6-foot sheepsfoot	30
Loader (2 cubic yards)	1	Caterpillar 950	30
Water truck	1	2,000 gal	30
Dump truck	1	12 yard	30
Pickup trucks (crew transportation)	2	Ford F250	30
Concrete pumping truck	1	300 hp diesel	7
Concrete hauling truck (8 cubic yards)	5	300 hp diesel	7

* Estimated usage is based on 5 working days per week, at 8 hours per day.

It is likely that any construction or oversize trucks would access State Route (SR) 246 from Highway (Hwy) 101 (Figures 1-1 and 1-2). From the north, SR 246 would be accessed through the city of Lompoc, at Hwy 1 (H Street) and Ocean Avenue (Figure 1-2). This route is not likely to be used as it entails traversing the entire length of Lompoc. It is more likely that any large construction trucks or oversize trucks would travel south on Hwy 101 to SR 246 in Buellton, CA, and take SR 246 west to either the South Gate or the Coast Gate (depending on the truck's size).

Workers and construction equipment for this project would likely access the Base through the South VAFB Gate, and proceed south on Arguello Road, then west on Bear Creek Road to access Coast Road. They would proceed south on Coast Road until reaching Kelp Road, and then proceed east on Kelp Road to SLC-4W. Oversized trucks bringing construction materials would likely take SR 246 to its terminus and enter VAFB through the Coast Gate. They would then proceed south on Coast Road until reaching Kelp Road and then proceed west to SLC-4W.

2.3.2 Falcon 9 Boost-Back and Landing

SpaceX proposes to return the Falcon 9 Full Thrust First Stage to SLC-4W at VAFB for potential reuse. After the First Stage engine cutoff, concurrent to the second stage ignition and delivery of the payload to orbit, exoatmospheric cold gas thrusters would be triggered to flip the First Stage into position for retrograde burn. Three of the nine First Stage Merlin 1D engines would restart to conduct the retrograde burn to reduce the velocity of the First Stage and to place the First Stage in the correct angle to land. Once the First Stage is in position and approaching its landing target, the three engines would be cut off to end the boost-back burn. The First Stage should then perform a controlled descent using atmospheric resistance to slow the stage down and guide it to the landing pad target. The First Stage is outfitted with grid fins that allow cross range corrections as needed. The landing legs on the First Stage would then deploy in preparation for a final single engine burn that should slow the First Stage to a velocity of zero before landing on the landing pad at SLC-4W. Figure 2-2 provides a graphical depiction of the boost-back and landing sequence.

The frequency of boost-back and landings at SLC-4W of the Falcon 9 Full Thrust First Stage would be up to six per year. Operation of the facility would be completed by existing onsite personnel.

Boost-back trajectories would be specific to each particular mission, but would fall within lower and upper limit azimuths (153 degrees to 301 degrees), as defined for the Western Range in Volume 1 (1 July 2004) of the AFSPCMAN 91-710, *Range Safety Requirements*. Figure 2-3 shows an example of the boost-back trajectory of the First Stage (depicted by the green path) and the second stage trajectory (depicted by the yellow path). The detailed sequence of events for First Stage landing along with trajectory data would be provided in the Flight Safety Data Plan (FSDP) once it is finalized.

SpaceX would submit a Final Flight Data Package (FFDP) to the 30th Space Wing, Office of the Chief of Safety (30 SW/SE) specific to each particular mission to assess the acceptance of flight and determination of the hazards to the general public. The FFDP would include information on the boost-back and landing at an offshore location 31 mi. (50 km) offshore from VAFB. This data would be used to perform launch vehicle risk assessments, develop in-flight abort criteria and identify risk mitigation measures (evacuation of launch area, define hazardous airspace/seascape, etc.) to ensure safety of flight. Each stage of the Falcon 9 vehicle would have an USAF approved Flight Termination System that would be used to terminate flight if any of the predetermined flight criteria are violated during flight. The landing trajectory would take into account all valuable assets to minimize risk of impact from potential debris corridors if the flight must be terminated. Over-flights of manned assets may not be feasibly avoided during all boost-back events. In these cases, all manned facilities are already evacuated during the launch and would remain evacuated during the boost-back, since the boost-back occurs immediately after the launch.

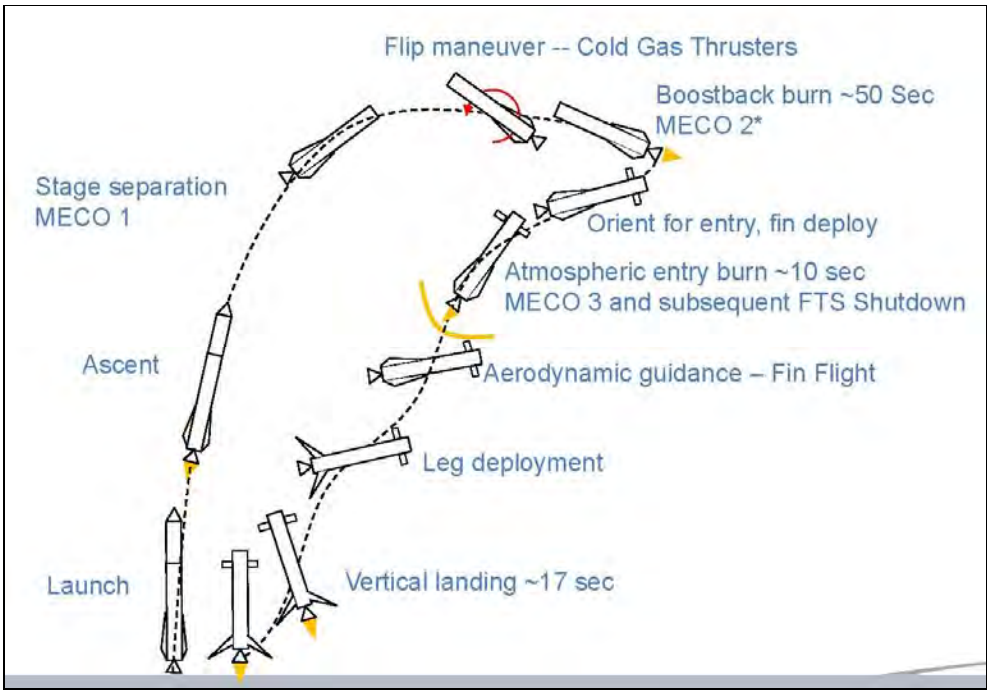

Figure 2-2. Stages of Boost-Back and Propulsive Landing

During descent, a sonic boom (overpressure of high energy impulsive sound) would be generated while the first-stage booster is supersonic. The overpressure would be directed at the coastal area south of SLC-4 and would reach as high as 2.0 pounds per square foot (psf) on VAFB. The Northern Channel Islands may experience a sonic boom of 3.1 psf. Figures 2-4 and 2-5 show the modeled sonic boom of a landing event with an incoming trajectory for a light payload and heavy payload. Engine noise would also be produced during the landing of the Falcon 9 Full Thrust First Stage, but it would be less than the noise generated during the launch (see Figure 2-6). The sonic boom and landing noise are an expected part of the Proposed Action and help define the region of influence for the affected environment. As such, they are described here and the effects of the expected sonic boom and landing noise are described in Chapter 4 (Environmental Consequences).

Although propellants would be burned to depletion during flight, there is a potential for approximately 7,000 lb. of densified LOX and a maximum of 2,750 lb. of RP-1 to remain in the Falcon 9 Full Thrust First Stage upon landing. Final volumes of fuel remaining in the First Stage upon landing may vary and would be included in the FSDP.

Safing activities would begin upon completion of all landing activities and engine shutdown. The LOX oxidizer system would be purged, and any excess fuel would be drained into a suitable truck mounted container or tanker for disposal or re-use. Any remaining pressurants (i.e., helium or nitrogen) would be vented, and any flight termination system (FTS) explosives would also be rendered "inert" prior to declaring the vehicle safe. The vehicle would then be lifted and placed on to the stand; the landing legs would then be removed or folded back into place. The vehicle would then be lowered into a horizontal position, placed on a transport vehicle and taken to a

post-processing facility. A ground crew would perform and supervise all landing operations and would be familiar with the operating protocol including all potential "off nominal" events.

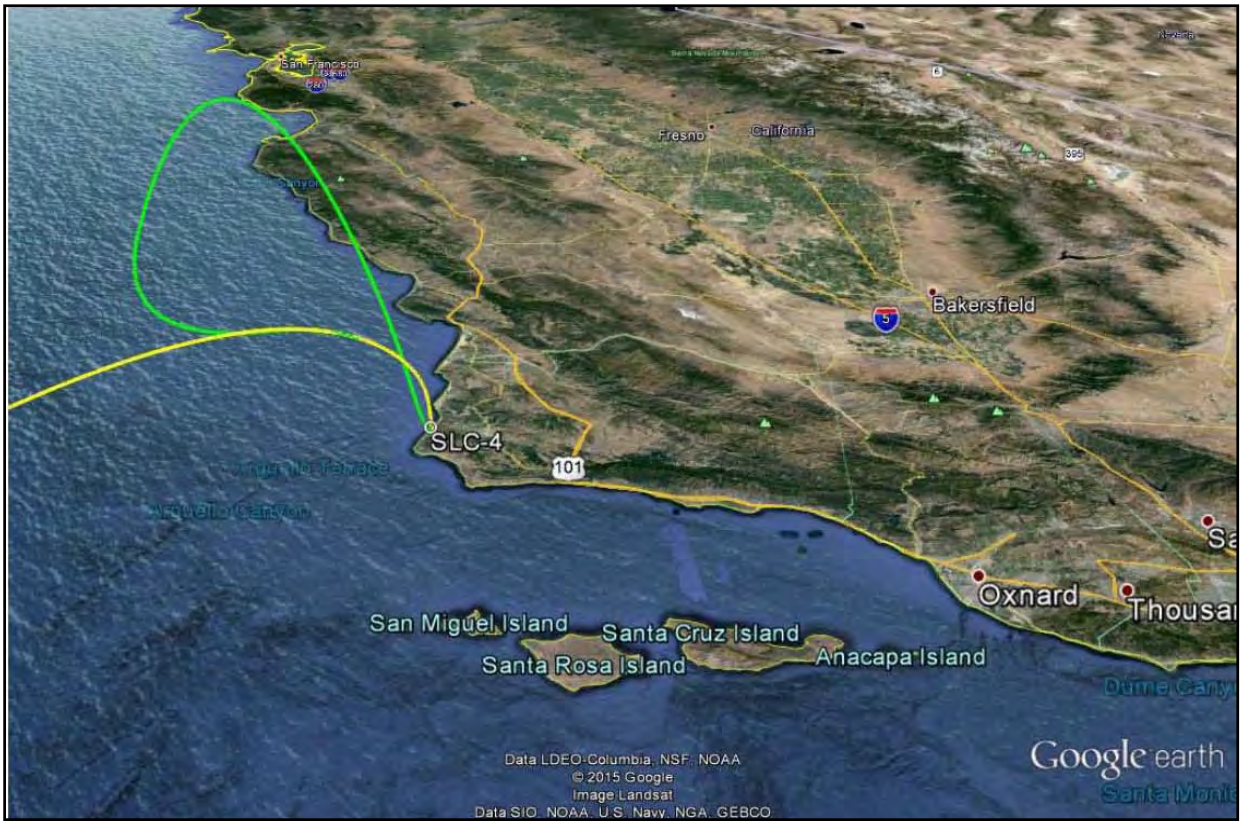

Figure 2-3. Trajectories for the First Stage Return Path (green line) and Second Stage Path (yellow line) of the Falcon 9 for a landing at SLC-4W on VAFB

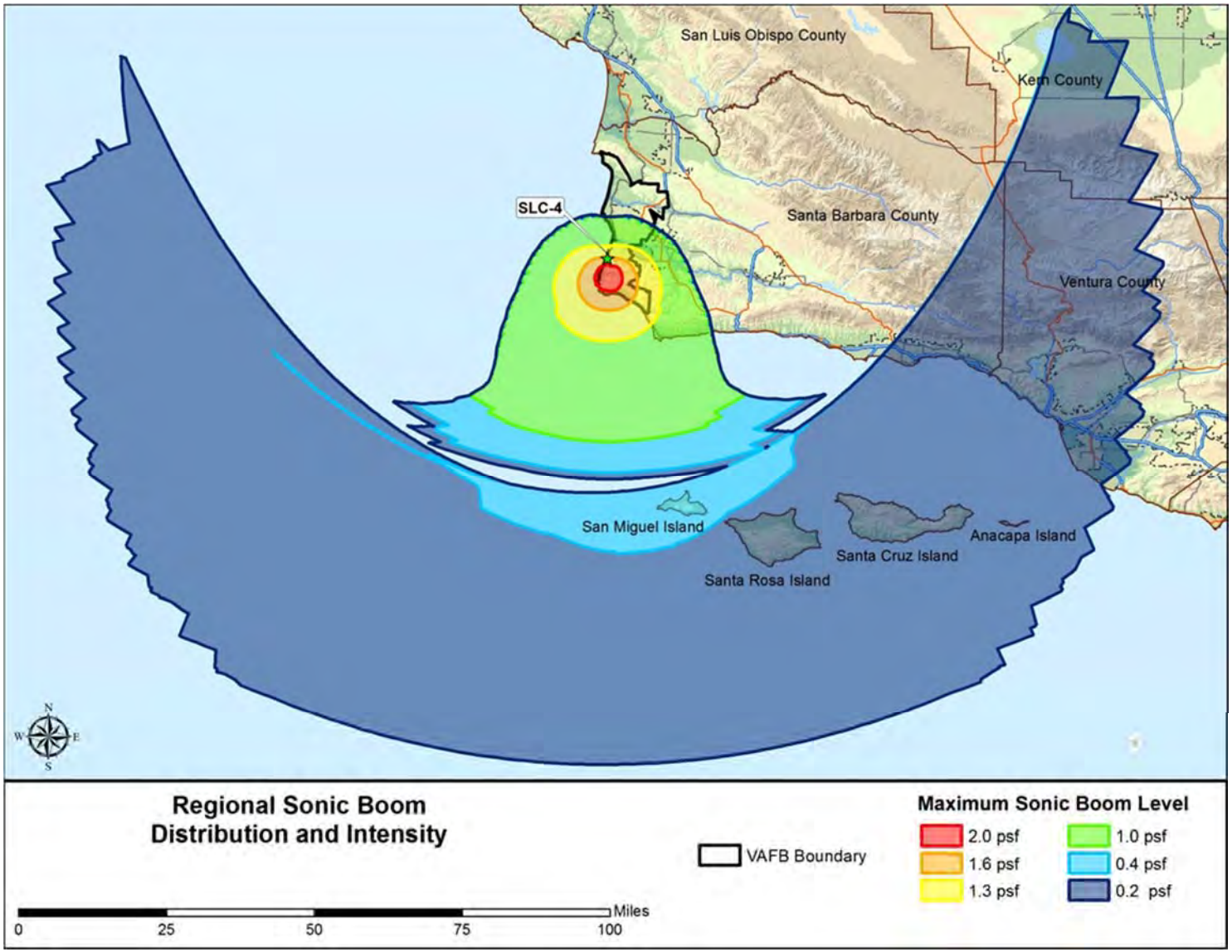

Figure 2-4. Regional Sonic Boom Distribution and Intensity for Pad Landing at SLC-4W with an Incoming Trajectory for a Light Payload on VAFB

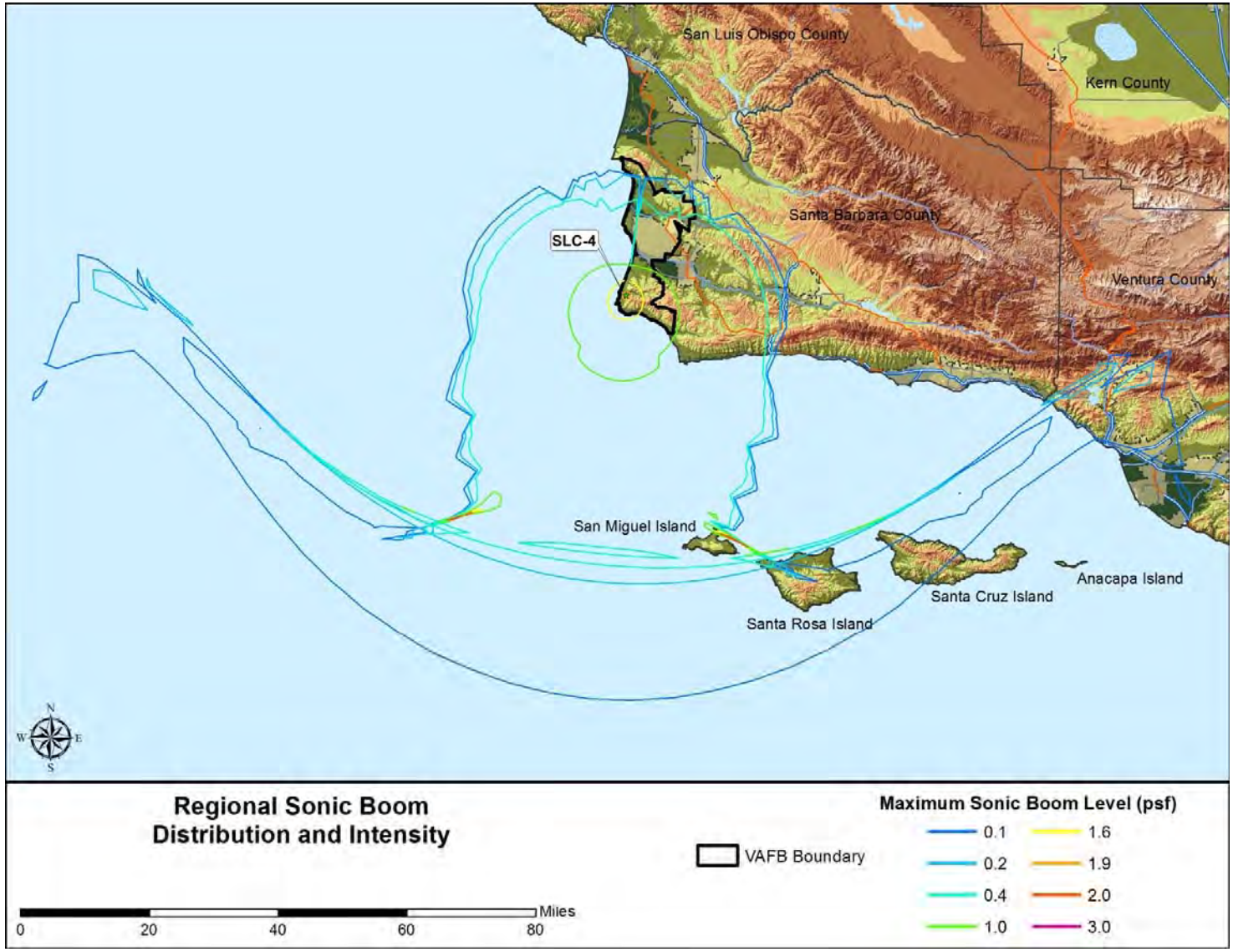

Figure 2-5. Regional Sonic Boom Distribution and Intensity for Pad Landing at SLC-4W with an Incoming Trajectory for a Heavy Payload on VAFB

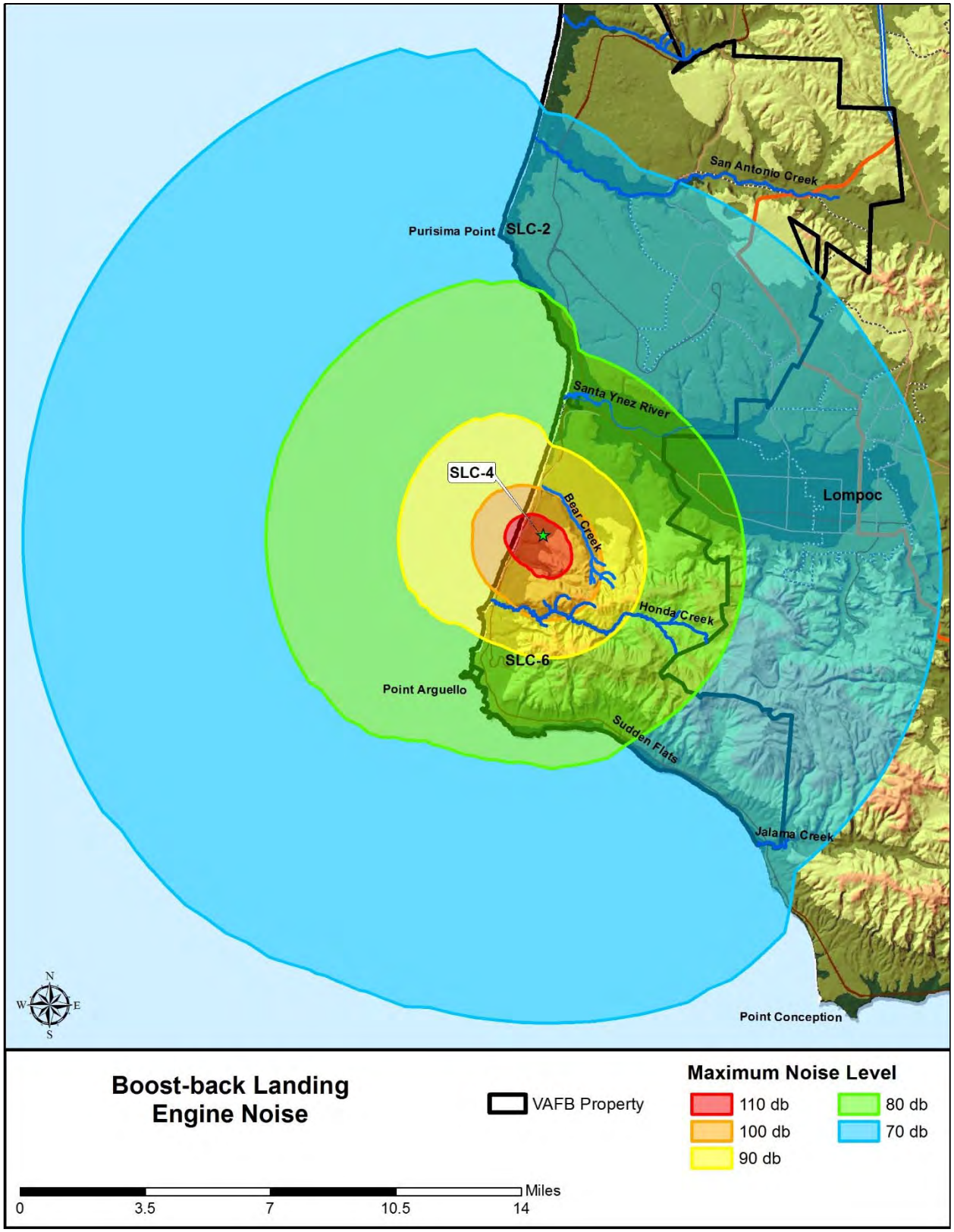

Figure 2-6. Regional Landing Noise Intensity Map for Pad Landing at SLC-4 on VAFB

2.3.2.1 Contingency Drone Ship Landing

As a Contingency Action to landing the Falcon 9 Full Thrust First Stage on the SLC-4W pad at VAFB, SpaceX proposes to return the Falcon 9 Full Thrust First Stage to a drone ship, specifically designed to be used as a landing platform for the First Stage, and located no less than 31 mi. (50 km) offshore of VAFB (Figure 2-7). The contingency action is necessary to provide for an alternative landing location if the Western Range deems that the first stage overflight of south VAFB is unacceptable due to potential impacts to critical assets or weather conditions or mission parameters do not permit for a successful landing attempt. The contingency landing location is the furthest from the coastline that SpaceX is able to place the landed stage and maintain the same boost-back trajectory as for a land landing at SLC-4W. It is important for Range Safety analysis that the trajectory for a drone ship landing is the same as land landing to verify stage-landing performance.

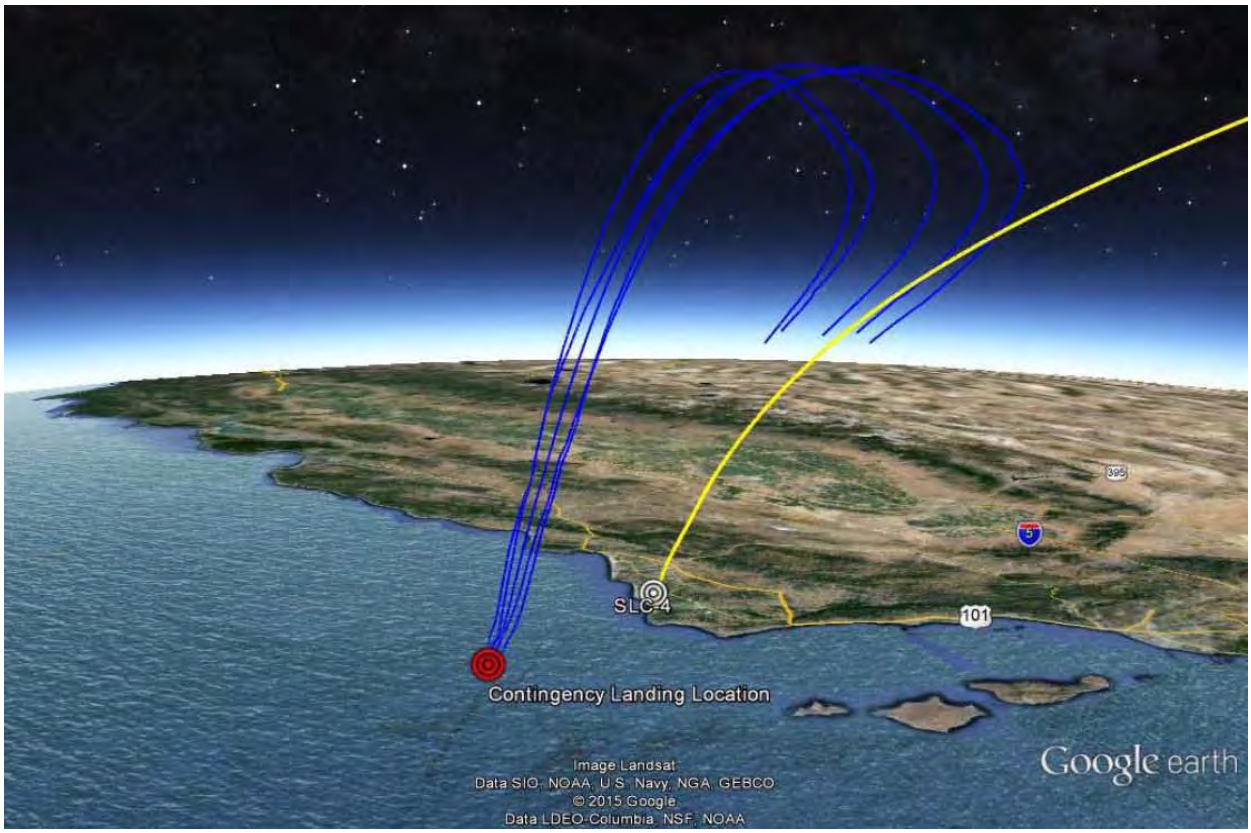

Figure 2-7. Trajectories for Variations of the Contingency First Stage Return Path to a Drone Ship Landing Location 31 mi. (50 km) off of VAFB (blue lines) and Second Stage Path (yellow line)

The maneuvering and landing process described above for a pad landing would be the same for a drone ship landing. Prior to a drone ship landing a notice to mariners and a notice to air man for all pilots would be issued via the Range.

Three vessels would be required for a drone ship landing:

1. Drone Ship/Landing Platform – approximately 300 ft. (91.4 m) long and 150 ft. (45.7 m) wide
2. Support Vessel – approximately 165 ft. (50.3 m) long research vessel
3. Ocean Tug – 120 ft. (36.6 m) open water commercial tug

The support vessels would originate from Long Beach Harbor to position for support for contingency landings. The tug and support vessel would be staged just outside of the landing location. The drone ship to be used as the landing platform is a McDonough Marine Deck Barge with dimensions of 300 ft. (91.4 m) by 100 ft. (30.5 m) (Figure 2-8). The barge has an operational displacement of 24,000,000 lb. and is classified as an American Bureau of Shipping Class-A1 Ocean barge. The Barge was modified to accommodate the First Stage landing by increasing its width to 150 ft. (45.7 m) and installing a dynamic positioning system and a redundant communications and command and control system. Following barge modification, the drone ship was inspected by the U.S. Coast Guard, and SpaceX has obtained a Certificate of Inspection (COI) for its operation under the service of Research Vessel.

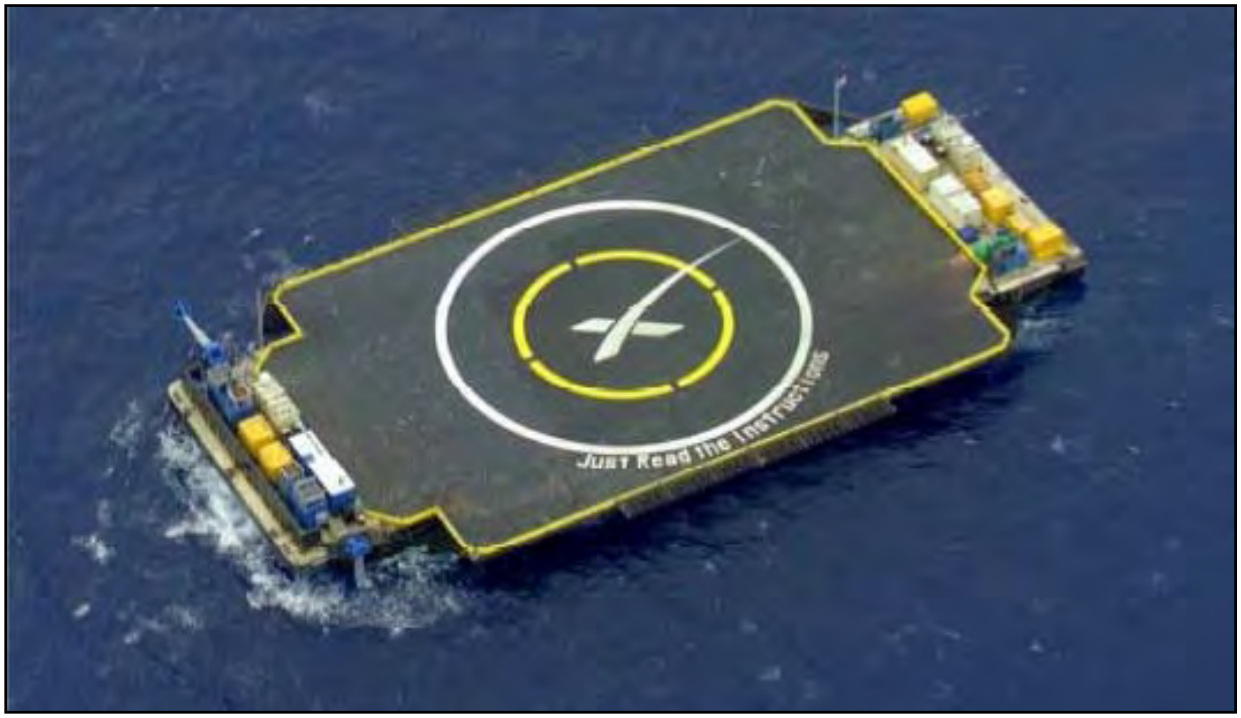

Figure 2-8. Drone Ship Landing Platform

The Support Vessel is a 165 ft. (50.3 m) long research vessel that is capable of housing the crew, instrumentation and communication equipment, and supporting debris recovery efforts, if necessary. The U.S. Coast Guard would have a representative on this vessel during the operation and a representative in the Launch and Landing Control (LLC) on VAFB to coordinate required clears and approve access back to the drone ship after the landing.

The Tug is a 120 ft. (36.6 m) open-water commercial ocean vessel. The primary operation of the tug is to tow the drone ship into position at the landing site and tow the drone ship and rocket back to Long Beach Harbor. After landing, the First Stage would be secured onto the drone ship and transported to the Long Beach Harbor for off-loading and transport to a SpaceX testing facility in McGregor, Texas to complete acceptance testing again before re-flight. Once testing is completed, it would be transported back to the SLC-4W pad or another SpaceX launch facility for reuse. Hazardous materials would be off-loaded from the First Stage after the drone ship is docked in Long Beach Harbor (see Section 2.3.2, Falcon 9 Boost-Back and Landing, for discussion of fuels).

During descent, a sonic boom (overpressure of high energy impulsive sound) would be generated while the first-stage booster is supersonic. The overpressure would be directed at the ocean surface no less than 31 mi. (50 km) off the coast of VAFB. SpaceX contracted Wyle to perform a noise analysis for a boost-back landing on the pad at VAFB, and Wyle determined sonic overpressures would reach as high as 2.0 psf approximately 6 mi. (3.7 km) south of SLC-4 and 3.1 on the Northern Channel Islands (Figures 2-4 and 2-5; Wyle 2015). The SLC-4W pad-based landing overpressure modeling was roughly extrapolated to show potential noise impacts for landing 31 mi. (50 km) to the west of VAFB. This extrapolation suggests that the maximum overpressure that would impact land during a drone ship landing would be 0.4 psf (Figures 2-9 and 2-10).

Engine noise would also be produced during the drone ship landing of the Falcon 9 Full Thrust First Stage; similar to the sonic boom intensity estimation, data extrapolation from the pad landing suggests that engine noise would not be heard on land from this action (Figure 2-11).

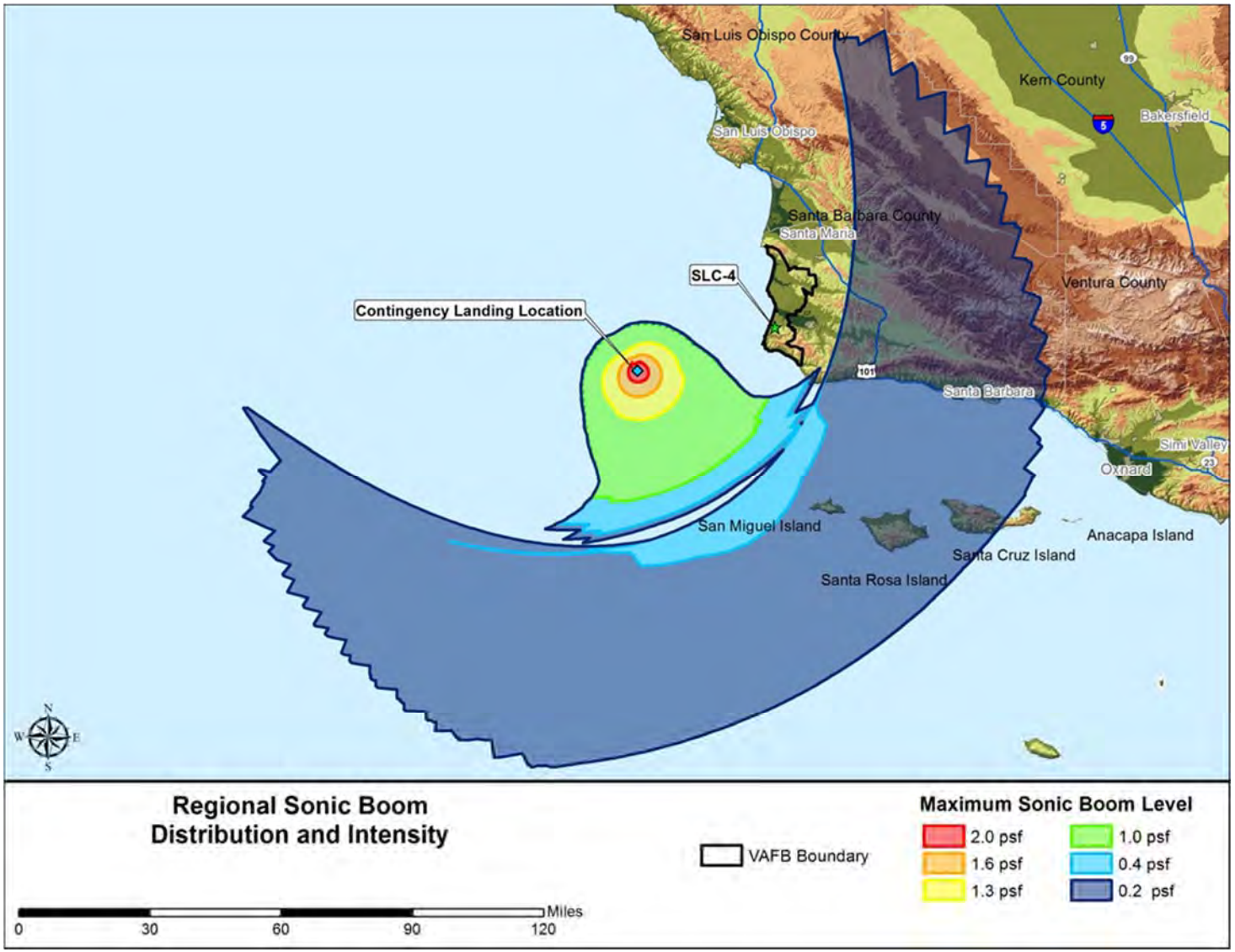

Figure 2-9. Hypothetical Sonic Boom Overpressure for Contingency Action of Drone Ship Landing 31 mi. (50 km) Offshore of VAFB with an Incoming Trajectory for a Light Payload

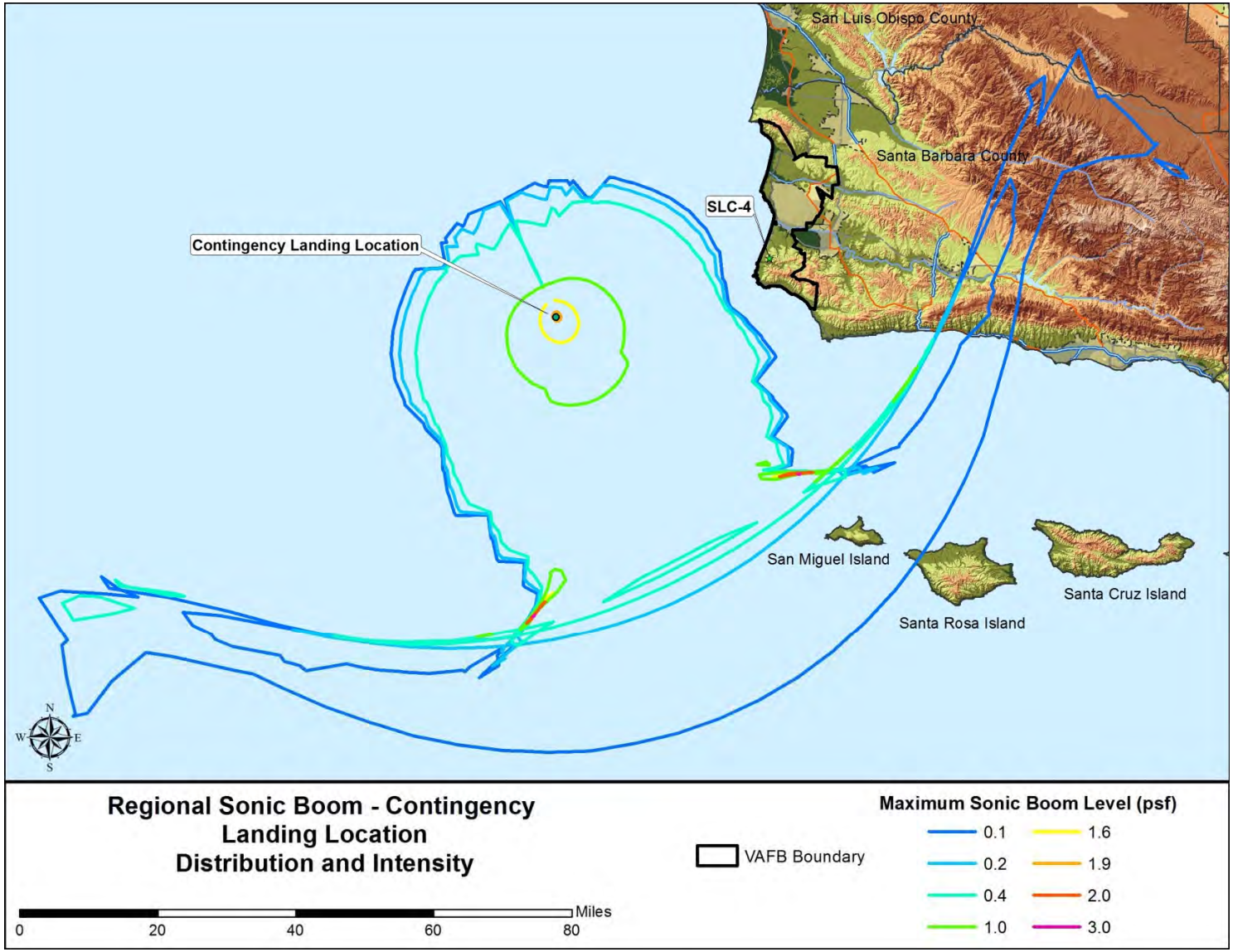

Figure 2-10. Hypothetical Sonic Boom Overpressure for Contingency Action of Drone Ship Landing 31 mi. (50 km) Offshore of VAFB with an Incoming Trajectory for a Heavy Payload

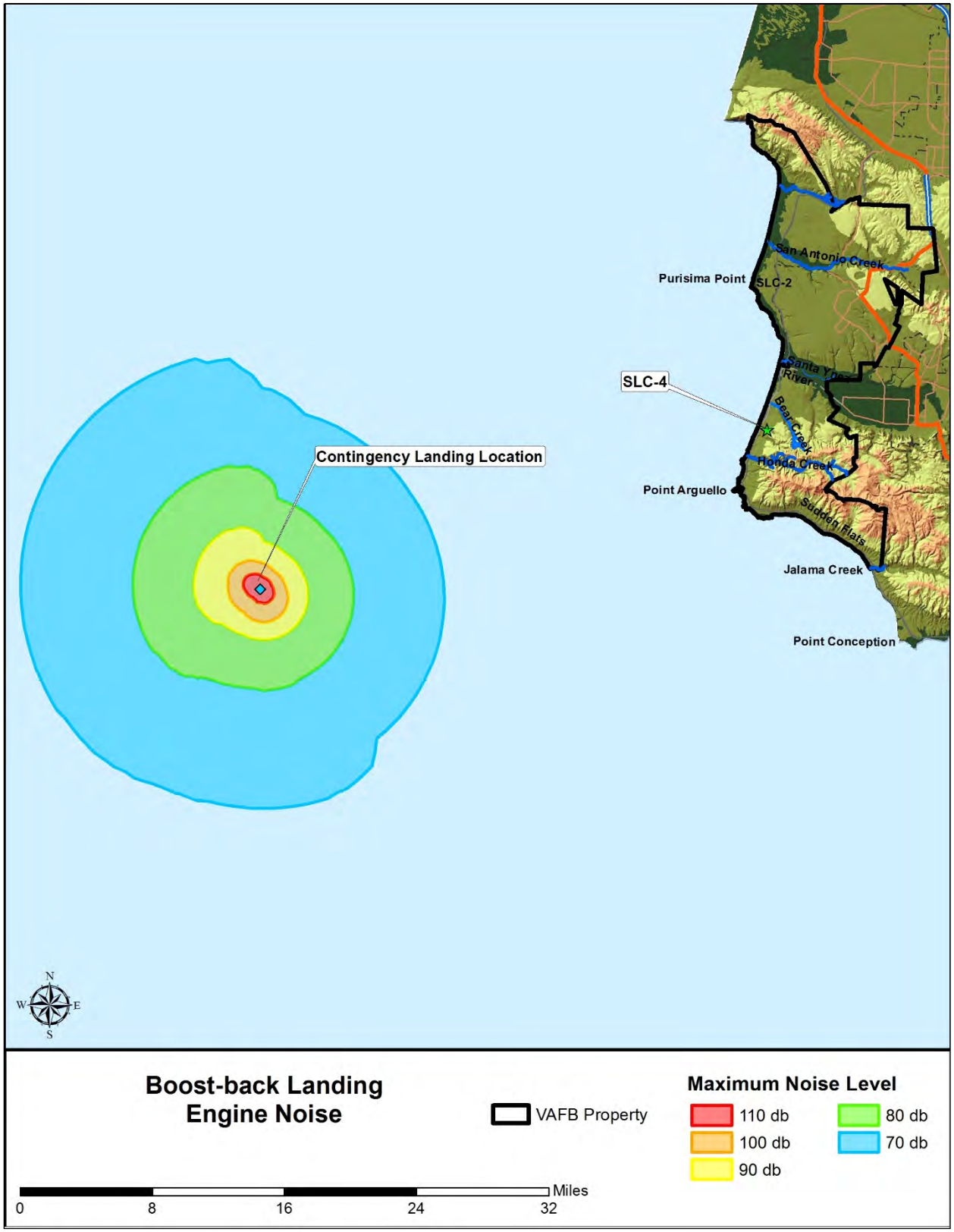

Figure 2-11. Approximate Regional Landing Noise Intensity Map for Contingency Action Drone Ship Landing 31 mi. (50 km) off of VAFB

2.3.2.1.1 Concept of Operation for Drone Ship Landing

The following outlines the concept of operation for a drone ship landing. All times are correlated to a launch time of T-0:

T-12 Hours	Drone ship/landing platform on-station and crew begins system activations
T-6 Hours	Tow line is released and the drone ship is holding position via the dynamic positioning system
T-4 Hours	The crew transfers from the drone ship to the support vessel
T-2 Hours	The support vessel departs the area to a pre-determined staging area, and VAFB Range Safety is notified
T-1 Hour	The support vessel is at the staging area and Range Safety has been notified
T+8 minutes	Landing occurs
T+10 minutes	Range Safety confirms it is safe for the support vessel and tug to return to the landing site and conveys permission to reenter area
T+60 minutes	The support vessel and tug are back at the landing site
T+2 hours	The drone ship/landing platform is secured to the tow line for towing to Long Beach Harbor

T- = time to scheduled launch; T+ = time after launch

2.3.2.1.2 For an Unsuccessful Drone Ship Landing Attempt

SpaceX has attempted drone ship landings on three separate occasions, two off the coast of Florida and one off the coast of California (Figure 2-12). All of these attempts were not successful and resulted in the First Stage impacting the drone ship and exploding. A photograph of the drone ship after one of the unsuccessful landing attempts is shown in Figure 2-13. In the event of an unsuccessful landing attempt, the First Stage would explode upon impact with the drone ship. A system safety analysis was performed by Bastion Services related to First Stage recovery operations. This analysis concentrated on safety hazards related to an unsuccessful First Stage landing attempt. The explosive equivalence of the First Stage with maximum fuel and oxidizer is 503 lb. of trinitrotoluene (TNT). This amount of TNT would be capable of generating a maximum projectile range of 1,250 ft. (381 m) from the point of impact.

SpaceX has experience performing recovery operations after unsuccessful drone ship landings for previous Falcon 9 Full Thrust First Stage landing attempts. This experience, in addition to the debris catalog that identifies all floating debris, has revealed that approximately 25 pieces of debris remain floating after an unsuccessful drone ship landing. The surface area potentially

impacted with debris would be less than 114 ac. (0.46 km^2), and the vast majority of debris would be recovered. All other debris sinks to the bottom of the ocean.

Figure 2-12. Drone Ship Landing Attempt

Figure 2-13. Drone Ship Landing Platform after an Unsuccessful Landing Attempt

These 25 pieces of floating debris are primarily made up of Carbon Over Pressure Vessels (COPVs), the LOX fill line, and carbon fiber constructed landing legs. SpaceX has performed successful recovery of all of these floating items during previous landing attempts. An unsuccessful drone ship landing would result in a very small debris field, making recovery of debris relatively straightforward and efficient. All debris recovered offshore would be transported back to Long Beach Harbor.

Upon impact with the drone ship, the First Stage should contain at most 2,750 lb. of RP-1 on board. If the landing is unsuccessful, most of this fuel would be consumed during the subsequent explosion; residual fuel would be released onto the drone ship deck at the location of impact. In cases where the First Stage booster misses the drone ship entirely, SpaceX's scientists assume that 2,750 lb. of RP-1 would be released into the ocean. Final volumes of fuel remaining in the First Stage upon landing may vary and would be included in the FSDP, but SpaceX's scientists anticipate it to be below the high range estimations. Very light oils, including RP-1, are highly volatile, which means they evaporate quickly when exposed to the air, and are usually completely dissipated within 1–2 days after a spill. Clean-up following a spill is usually not necessary, or possible, with spills of very light oil, particularly with such a small quantity of oil (U.S. Fish and Wildlife Service 1998). Therefore, no attempt would be made to boom or recover RP-1, if any of the fuel is released directly into the ocean. Any RP-1 remaining on the drone ship deck from an unsuccessful landing attempt would be recovered, contained, and handled per federal, state, and local agency requirements.

The trajectory path of the First Stage for a drone ship landing is shown in Figure 2-7. The explosion of the First Stage would generate an in-air impulsive noise that would propagate in a radial fashion away from the drone ship. Based on the size of the anticipated explosion, Sadovsky equations were used to calculate peak received levels (received levels are a function of charge weight and distance from source) at sound pressure contour lines. Since the sound pressure levels were peak levels, the approximate root mean squared (RMS) values were estimated by converting peak to RMS (peak pressure value * 0.707). These values were then converted into decibels referenced to 20 micropascals (dB re 20 μPa) to determine distances to defined contour levels and in-air threshold levels. To generate realistic sound pressure contour lines, atmospheric attenuation was included in the model. Calculations for atmospheric attenuation included the following assumptions: the explosion was assumed to be 250 hertz (Hz) or less, relative humidity was assumed to be 30 percent, and air temperature was assumed to be 50 degrees Fahrenheit (°F). Figure 2-14 depicts decibel (dB) contours from the source level (150–180 dB) to 16.5 mi. (26.5 km), at which point the blast wave would deteriorate to 90 dB. This model does not take into account additional factors that would attenuate the blast wave further, including sea surface roughness, changes in atmospheric pressure, frontal systems, precipitation, clouds, and degradation when encountering other sound pressure waves. Thus, the estimated area of exposure is conservatively overestimated.

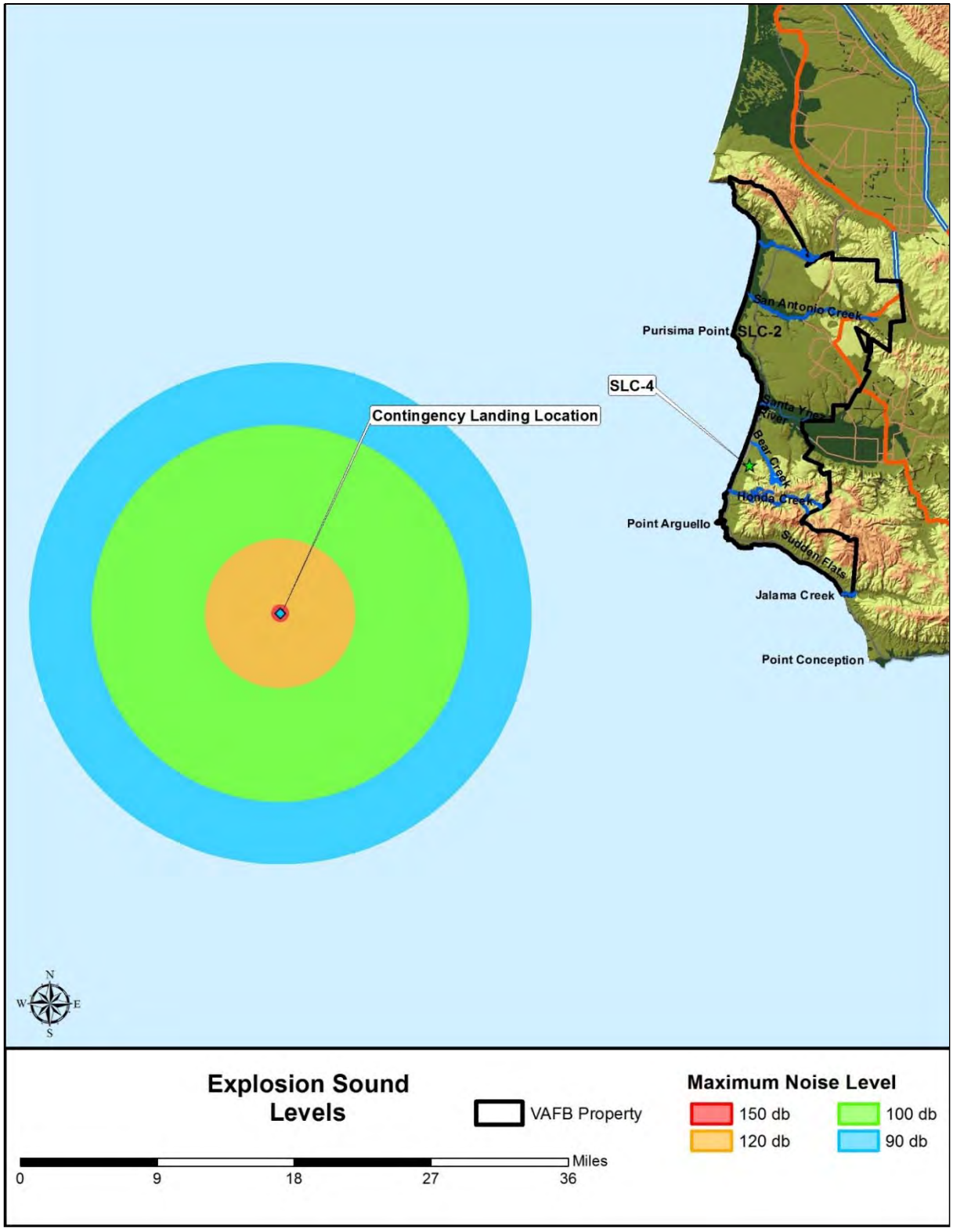

Figure 2-14. Estimated Explosion Blast Noise Intensity Map for an Unsuccessful Drone Ship Landing 31 mi. (50 km) off VAFB

2.3.3 Autonomous Flight Safety System

The launch vehicle would be equipped with both a thrust termination and a destructive flight termination system in the event it varied from the planned trajectory. The thrust termination system is activated by a command from the appointed officer from the 30 SW Safety (30 SW/SE) and disables power to the vehicle engines. Once power is removed, there are up to six different valves that close and immediately shut off the first stage engines. Four valves close on the second stage, again shutting down the stage's engines. Thus, upon activation of the thrust termination system, the Falcon 9 launch vehicle would fall intact and may explode upon impact, depending on the circumstances and time in the flight when the termination is activated. The flight termination system also includes linear shaped charges intended to rupture the vehicle tanks when commanded to destruct, thus dispersing propellants. In this event, the debris would impact a wider area but in smaller pieces. The termination method selected by 30 SW/SE officer would be based on the vehicle's trajectory and its payload.

In addition, the AFSS would be used as the primary FTS after three certification flights and completion of qualification testing by 30 SW/SE. The AFSS uses a Global Positioning System (GPS) aided, onboard computing system to process flight performance data and compare against precompiled mission rules determined by the 30 SW/SE. The use of existing 30 SW "mission rules" provides the criteria used to determine if a flight should be terminated in exactly the same way the Mission Flight Control Officer would do in the existing concept of operations. If, and when, a violation is detected the system activates explosive shape charges on both stages of the vehicle, in the same way as the current systems. These charges are designed to rupture the vehicle propellant tanks and primary structure, thereby ensuring that the vehicle is cleanly destroyed and the flight effectively terminated. The AFSS would use the same ordnance as the manned FTS in the event of an erratic or out of control flight.

2.3.4 Environmental Protection Measures

Implementation of the environmental protection measures (EPMs) outlined below would avoid or minimize potential adverse effects to various environmental resources during implementation of the Preferred Alternative. Mandatory EPMs (denoted by "shall" or "would") are part of the project design and would be implemented as part of the Proposed Action so as to avoid, minimize, reduce or compensate for the anticipated potential environmental impacts. Discretionary measures (denoted by "may" or "could") may or may not be implemented to further reduce environmental impacts. Implementation of all measures would be overseen by qualified SpaceX personnel or contractor staff.

2.3.4.1 Air Quality – 1 (Air-1)

The following measures would be implemented to control fugitive dust emissions during ground-disturbing activities:

- Water trucks or sprinkler systems would be used to keep all areas of vehicle movement damp enough to prevent dust from leaving the site. At a minimum, this would include wetting down areas in the late morning and after work is completed for the day. Watering

frequency would be increased when wind speeds exceed 15 mi. per hour (mph). Whenever possible, reclaimed water would be used. The use of excessive amounts of water, which could cause runoff or erosion, would be avoided.

- The amount of disturbed area at any given time would be minimized by limiting disturbance to the smallest area practicable.
- On-site vehicle speeds would be reduced to a maximum of 15 mph.
- Gravel pads or rumble plates would be installed at all access points to prevent tracking mud onto public roads.
- After clearing, grading, earth moving, or excavation are completed, the disturbed area would be treated by watering, revegetating, or spreading soil binders until the area is replanted.
- Outbound trucks hauling construction debris (or any material that would generate visible fugitive dust beyond the property line) would utilize one of the following measures:
    a. Use properly secured tarps or cargo covering that covers the entire surface area of the load or use a container-type enclosure.
    b. Maintain a minimum of 6 inches of freeboard below the rim of the truck bed where the load touches the sides of the cargo area and ensure that the peak of the load does not extend above any part of the upper edge of the cargo area.
    c. Water or otherwise treat the bulk material to minimize loss of material to wind or spillage.
- A person or persons would be designated to monitor the dust control program and to order increased watering, as necessary, to prevent transporting dust off-site. The name and telephone number of the dust control monitor would be provided to the Santa Barbara County Air Pollution Control District (SBCAPCD) prior to the issuance of grading/building permit issuance.

2.3.4.2 Air Quality – 2 (Air-2)

The following measures would be implemented to reduce nitrogen oxide (NO_x) and fine particulate matter ($PM_{2.5}$) emissions from construction equipment:

- Before construction begins, portable equipment meeting the criteria defined in the Emergency Regulation Order, effective 27 April 2007 for the California PERP would be registered in the program or have a valid SBCAPCD Permit to Operate.
- Whenever feasible, heavy-duty diesel-powered construction equipment manufactured after 1996 would be used. However, Tier 2 and up compliant vehicles that meet the California Air Resources Board's (CARB) In-Use Off-Road Diesel Vehicle Regulation are preferred.
- Construction equipment having the minimum practical engine size would be used.
- Construction equipment would be maintained per manufacturer's specifications.
- If available, construction equipment with diesel catalytic converters, diesel oxidation catalysts, and diesel particulate filters that are certified by the U.S. Environmental Protection Agency (USEPA) or CARB would be used.

- Idling of heavy-duty diesel trucks during loading or unloading would be limited to 5 minutes.
- Worker trips would be minimized through carpooling.
- All applicable 1996 and older engine model diesel-vehicles with a gross vehicle weight rating (GVWR) between 14,001 and 26,000 lb. (e.g., trucks delivering materials, water trucks and cement mixers) must meet 2010 manufacturing year engine emission standards as specified in the CARB Regulation to Reduce Emissions of Diesel Particulate Matter, Oxides of Nitrogen and Other Criteria Pollutants from In-Use Heavy-Duty Diesel-Fueled Vehicles.
- All applicable in-use heavy-duty diesel-fueled vehicles with a GVWR greater than 26,000 lb. (e.g., trucks and buses) must meet particulate matter best available control technology and engine model year emission requirements as specified in the CARB Regulation to Reduce Emissions of Diesel Particulate Matter, Oxides of Nitrogen and Other Criteria Pollutants from In-Use Heavy-Duty Diesel-Fueled Vehicles.

2.3.4.3 Biological Resources – 1 (Bio-1)

The following measures would be implemented to minimize potential impacts on native plant communities:

- The project footprint would minimize to the extent practicable to limit damage to native plant communities.
- When it is not practical to stage or operate project vehicles or equipment on paved or existing roadways and trails, vehicles and equipment would be staged and operated on nonnative vegetation to the maximum extent practicable.
- Native vegetation that is temporarily disturbed or removed during construction would be revegetated with local natives from VAFB's approved planting lists. Native species seeds would be purchased from a nursery with seed stock from a local source or collected in the vicinity of the disturbed area and used for revegetation either through planting of container plants, hydroseeding, or a combination of both.
- If a hydroseed mix is used, the hydroseed mix would be checked for the presence of potentially invasive species.
- In cases where short-term access is necessary, rubber-tired vehicles would be used to leave native vegetation intact and to minimize soil disturbance.
- In areas that are not required to be maintained as cleared areas, stumps would be left in place to facilitate regeneration. If complete clearing is necessary, the width and extent of cleared areas would be kept to a minimum. The number and footprint of access routes to a given area would also be minimized.
- Vehicles and equipment would be inspected and cleaned before use at a new site. Clothing would likewise be cleaned and inspected between sites.
- Weed-free materials, such as gravel, mulch, fill, and hay, would be used for construction and erosion control.

2.3.4.4 Biological Resources – 2 (Bio-2)

The following measures would be implemented to minimize potential impacts on federally listed species protected under the jurisdiction of the USFWS, in addition to the following EPMs:

- Prior to conducting any project activities, a qualified biologist would clearly mark sensitive species and habitats within the project site and the immediate area to prevent workers or equipment from adversely affecting species or habitats that are not expected to be damaged during the project.
- SpaceX would cover trenches, holes, and pipeline routes at the conclusion of project activities to avoid the entrapment of animals. If a project lasts for more than 1 day, the SpaceX would cover these areas or provide an escape route.
- All applicable minimization, monitoring, and avoidance measures in VAFB's Biological Opinions pertaining to the project (8-8-14-F-41 [U.S Fish and Wildlife Service 2014] and the USFWS concurrence letter (2015-I-0208) would be implemented during construction and operation and maintenance of the project.

El Segundo Blue Butterfly

- Areas with seacliff buckwheat would be flagged and a 2-ft. buffer maintained where avoidance does not jeopardize fire suppression, security requirements, or program operation needs. If seacliff buckwheat is removed, El Segundo blue butterfly (*Euphilotes battoides allyni* [ESBB]) habitat would be enhanced following the ratio described below.
- If removal of or damage to seacliff buckwheat is necessary to meet fire suppression, security requirements, or program operation needs, a qualified biological monitor would be present to ensure impacts are minimized and quantified.
- To avoid potential impacts to adult ESBB, vegetation clearance and access road construction would occur outside of the ESBB flight season, 1 June through 15 September, if feasible.
- ESBB habitat would be enhanced at a 2:1 ratio (habitat enhanced: habitat affected). Enhancement activities would include herbicide treatment and hand removal of invasive plants, planting native seedlings, and sowing native seed. Herbicides would not be applied during the flight season (1 June through 15 September). USFWS-approved biologists would collect native seed for sowing and propagating buckwheat seedlings.
- An appropriate area for ESBB habitat enhancement activities would be selected by CEIEA that would not have impacts to sensitive species (i.e., an area currently occupied by invasive species, with no federally listed species present, and that is not anticipated for future development).
- Only buckwheat species that are native to VAFB would be planted. Habitat enhancement activities would be conducted after construction of the landing pad is complete and the area of affected habitat can be assessed. Planting would occur during the following late fall or early winter to coincide with the onset of the rainfall season.
- If more than 118 seacliff buckwheat plants are removed during SLC-4W site improvements, the USAF would reinitiate formal Section 7 consultation with the USFWS.

California Red-legged Frog

- If construction activities are conducted during the wet season and water is present in Spring Canyon, daily pre-construction surveys would be conducted to ensure that dispersing frogs have not entered the project site.
- If trenching activities occur during the wet season, open trenches would be inspected at the end of the day for the presence of California red-legged frog (*Rana draytonii* [CRLF]), covered at night, and inspected in the morning to determine whether CRLF have inadvertently become trapped in the trenches.
- A USFWS-approved biologist would relocate all life stages of CRLF found within the project site to the nearest suitable habitat outside of the project site but within the same watershed.
- If two adult, subadult, or juvenile CRLF are found dead or injured or if five are captured and relocated, the USAF would contact the USFWS Ventura office immediately to reinitiate formal Section 7 consultation. Project activities that are likely to cause additional take would cease during this review period.
- Silt fence would be installed in between the project site and Spring Creek to ensure no siltation occurs and to minimize dispersing frogs from entering the project site.

Southern Sea Otter

- Sonic boom modeling would be conducted prior to boost-back and landing events to determine the intensity and most likely impact locations.
- A USFWS-approved biologist would monitor southern sea otters (*Enhydras lutris nereis*) whenever a sonic boom of 1 psf or greater is predicted to be generated by the boost-back that would impact southern sea otter habitat. At a minimum, monitoring would be conducted during the initial three boost-back and landing events when a sonic boom of 1 psf or greater is predicted to impact sea otter habitat. If adverse effects are documented or the results of monitoring are inconclusive, monitoring would continue for subsequent boost-back and landing events until the nature of effects can be accurately determined.
- The monitoring locations would be selected based on where pressure waves greater than 1 psf are predicted to impact and the relation of these locations to sea otter habitat. The monitoring locations are generally expected to be on Sudden Flats on South VAFB.
- A USFWS-approved biologist would conduct daily counts of sea otters at each of the selected monitoring locations beginning 3 days before, and continuing 3 days after the boost-back and landing events. The monitor would note any mortality, injury, or abnormal behavior observed during these counts. Weather permitting, the counts would be conducted between 09:00 and 12:00, when otters are most likely to be rafting (Estes et al. 1986). This would maintain daily consistency in detectability. Monitors would use both binoculars (10X) and a high-resolution 50–80X telescope to conduct counts.
- Acoustic recording equipment would be deployed at or near the monitoring locations to document and quantify noise impacts.

California Least Tern

- Monitoring of foraging California least terns [*Sternula antillarum browni* (LETE)] at the Santa Ynez River estuary would be conducted, at a minimum, during the initial three boost-back and landing events that occur when LETE are present, when a sonic boom of 1 psf or greater is predicted to impact LETE foraging habitat to characterize any potential impacts from the Proposed Action. If adverse effects are documented or the results of monitoring are inconclusive, monitoring would continue for subsequent boost-back and landing events until the nature of effects can be accurately determined.
- A USFWS-approved biologist would conduct daily counts of LETE at the Santa Ynez River estuary beginning 3 days before boost-back and landing events through 3 days after. These data would be used to determine whether the Proposed Action had an effect on habitat use patterns within the impact area or caused any mortality, injury, or abnormal behavior.
- If there are no safety zone closures, foraging LETE at the Santa Ynez River estuary would be visually monitored during boost-back and landing events for daytime launches. Monitoring would be conducted by a USFWS-approved biologist.
- Acoustic recording equipment would be deployed at or near the monitoring location to document and quantify noise impacts.

Western Snowy Plover

- Between 1 March and 30 September, monitoring of nesting western snowy plover (*Charadrius nivosus* [SNPL]) would be conducted during boost-back and landing events to characterize potential impacts on SNPL reproductive success. At a minimum, monitoring would be conducted during the initial three boost-back and landing events during SNPL nesting season when a sonic boom of 1 psf or greater is predicted to impact SNPL breeding habitat. If adverse effects are documented or the results of monitoring are inconclusive, monitoring would continue for subsequent boost-back and landing events until the nature of effects can be accurately determined.
- Sonic boom modeling would be conducted prior to boost-back and landing events to determine the intensity, most likely impact locations, and whether SNPL breeding habitat would potentially be impacted by a sonic boom greater than 1 psf.
- If a sonic boom of 1 psf or greater is expected to impact SNPL breeding habitat during SNPL nesting season, a USFWS-approved biologist would monitor SNPL populations within the predicted impact area. Daily counts and nest monitoring would begin 3 days prior to boost-back and landing events and continue through 3 days after. These data would be used to determine whether the Proposed Action had an effect on habitat use patterns, population size within the impact area, nesting success, or caused any mortality, injury, or abnormal behavior.
- If there are no safety zone closures, active SNPL nests nearest to the peak sonic boom impact area would be monitored during boost-back and landing events during daytime launches. Monitoring would be conducted by a USFWS-approved biologist or via video depending feasibility and access constraints.

- Acoustic recording equipment would be deployed at or near the monitoring location to document and quantify noise impacts.

2.3.4.5 Biological Resources – 3 (Bio-3)

The following measures would be implemented to minimize impacts on other non-federally listed special-status species (e.g., migratory birds):

- Removal of shrubs would also be avoided to the extent possible during the nesting period for non-raptor species of 15 February through 15 August. If removal of shrubs is necessary during this period, a nesting bird survey would be conducted in the impact areas to determine the presence of nesting native birds. If active nests are found, activities would not be conducted in that area until young have fledged.

2.3.4.6 Biological Resources – 4 (Bio-4)

The following measures would be implemented to monitor potential impacts to offshore marine mammals and the offshore marine environment:

- Sonic boom modeling will be performed prior to each boost-back event. Launch parameters specific to each launch will be incorporated into each model to predict peak amplitudes and impact locations.
    - Should model results indicate that a peak overpressure of 1 psf or greater is likely to impact VAFB, then acoustic and biological monitoring will be implemented on VAFB.
    - If it is determined that a sonic boom of 1 psf or greater is likely to impact one of the Northern Channel Islands between 1 March and 30 June, greater than 1.5 psf between 1 July and 30 September, and greater than 2 psf between 1 October and 28 February, monitoring will be conducted at the haul out site closest to the predicted sonic boom impact area.
- Monitoring would commence at least 72 hours prior to the boost-back and continue until at least 48 hours after the event. Monitoring data collected would include multiple surveys each day that record the species; number of animals; general behavior; presence of pups; age class; gender; and reaction to booms or other natural or human-caused disturbances. Environmental conditions such as tide, wind speed, air temperature, and swell would also be recorded. If the boost-back is scheduled for daylight; video recording of pinnipeds on the Northern Channel Islands would be conducted during the boost-back to collect required data on reaction to launch noise
- Acoustic measurements of the sonic boom created during boost-back at the monitoring location would be recorded to determine the overpressure level.
- An appropriate compensatory mitigation plan will be implemented to offset adverse effects to EFH resulting from the discharge of unrecoverable marine debris.

2.3.4.7 Cultural Resources

The following measures would be implemented to minimize impacts on sensitive archaeological resources:

- If cultural resources are encountered during project-related ground-disturbing activities, all excavation would be halted to avoid disturbing the site or any nearby area reasonably suspected to include cultural resources. 30 CES/CEIEA would be contacted so that the significance of the find can be assessed.

2.3.4.8 Geology and Earth Resources

The following measures would be implemented to minimize erosion and impacts on stormwater quality during ground-disturbing activities:

- All entrances and exits to a construction site would be stabilized by, for example, using rumble plates, gravel beds, or other best available technology to reduce transport of sediment off-site. Any sediment or other materials tracked off-site would be removed within a reasonable time.
- Erosion and sediment control measures would be in place throughout grading and development of the site until all disturbed areas are permanently stabilized.
- Permanent roads shall be designed and constructed to prevent erosion and would require a gravel overlay or equivalent surface erosion control.

2.3.4.9 Human Health and Safety

The following measures would be implemented to minimize the potential for adverse impacts on human health and safety:

- All safety precautions for SLC-4 Operations and evacuation procedures for the project site area would be followed per Space Launch Vehicle Flight Hazard Zone requirements.
- SpaceX and subcontractors would comply with federal Occupational Safety and Health Administration (OSHA), Air Force Occupational Safety and Health (AFOSH), and California's Division of Occupational Safety and Health (Cal/OSHA) requirements for project activities occurring south of Honda Point (SLC-4W is located north of Honda Point and does not fall within the jurisdiction of Cal OSHA).
- SpaceX would prepare and submit a health and safety plan to VAFB and would appoint a trained individual as safety officer.
- SpaceX would continue to implement Land Use Control Procedures, as documented in the VAFB General Plan (U.S. Air Force 2014a).
- To minimize potential adverse impacts from biological hazards (such as from snakes and poison oak) and physical hazards (such as from rocky and slippery surfaces), awareness training would be incorporated into the worker health and safety protocol.
- SpaceX would coordinate with 30th Space Wing Weapons Safety Office (30 SW/SEW) to insure VAFB policies on unexploded ordnance (UXO) safety for construction work is incorporated into the site safety plan. The safety program would include coordination with the Air Force Civil Engineering Center, Environmental Center of Excellence

Operations (AFCEC/CZO) Military Munitions Response Program (MMRP) manager and contact with the weapons safety specialist for 30 SW/SEW.

2.3.4.10 Hazardous Materials and Waste

The following measures would be implemented to minimize impacts on hazardous materials and waste management:

- Measures would be taken to protect current wells related to remediation of groundwater around the site. There are three types of wells in the vicinity: monitoring wells, treatment wells, and extraction wells. Site activities would be conducted so as to protect wells that are in use and part of selected remedy as directed in the Final Record of Decision/Remedial Action Plan, VAFB Site 8c (U.S. Air Force 2013a).
- The fueling of vehicles and equipment would occur on impervious surfaces to the maximum extent practicable. Spill containment equipment would be present at all project sites where fuels or other hazardous substances are brought to the site. In addition, qualified personnel would conduct daily inspections of the equipment and the staging and maintenance areas for leaks of hazardous substances.

2.3.4.11 Solid Waste

Solid waste would be minimized by strict compliance with VAFB's Integrated Solid Waste Management Plan. Implementing the following measures would further minimize the potential for adverse impacts associated with solid waste:

- All materials that are disposed of off-base would be reported to the 30th Space Wing, Installation Management Flight (30 CES/CEI) Solid Waste Manager. Additionally, any materials recycled on-base by processes other than the base landfill, would be reported to the 30 CES/CEI Solid Waste Manager at least quarterly, with copies of weight tickets and receipts provided.

2.3.4.12 Water Resources

The following measures would be implemented to minimize impacts on water resources and stormwater:

- A site-specific Storm Water Pollution Prevention Plan (SWPPP) would be prepared for the project. Stormwater Best Management Practices (BMPs) would be selected and implemented following the latest California Stormwater Quality Association's (CASQA) Stormwater BMP Handbook.
- Geotextile fabrics, erosion control blankets, drainage diversion structures, or siltation basins would be used to reduce erosion and siltation into storm drains.
- All entrances and exits to a construction site would be stabilized by, for example, using rumble plates, gravel beds, or other best available technology to reduce transport of sediment off-site. Any sediment or other materials tracked off-site would be removed within a reasonable time.

- If present within the construction area, storm drain inlets would be protected from sediment-ladened waters by the use of inlet protection devices, such as gravel bag barriers, filter fabric fences, block and gravel filters, and excavated inlet sediment traps.
- Erosion and sediment control measures would be in place throughout grading and development of the site until all disturbed areas are permanently stabilized.
- Non-domestic wastewater would be handled, stored, and disposed of per the Construction General Permit and VAFB policy.
- Construction materials and waste, such as fuels, would be stored, handled, and disposed of in a manner that minimizes the potential for stormwater contamination. Bulk storage locations for construction materials and any measures proposed to contain the materials would be shown on final project plans.
- All disturbed soil areas shall be restored to have 70 percent density vegetation coverage or equivalent soil stabilization to meet the Notice of Termination requirements under Order No 2009-0009-DWQ (National Pollutant Discharge Elimination System [NPDES] Construction General Permit).
- Vegetation removal would be minimized.
- Permanent roads shall be designed and constructed to prevent erosion and would require a gravel overlay or equivalent surface erosion control.

2.4 Alternative 2 – First Stage Landing Site on Drone Ship in Pacific Ocean

Under this alternative, the construction of a landing pad at SLC-4W would not occur. The boost-back and landing of the First Stage would occur as described in Section 2.3.2.1 (Contingency Drone Ship Landing), except that it would land 320 mi. (322 km) offshore (Figure 2-15). All applicable EPMs described above would be implemented under Alternative 2. These would include EPMs under Section 2.3.4.4 (Biological Resources – 2 [Bio-2]) for southern sea otter, LETE, and SNPL, Section 2.3.4.6 (Biological Resources – 4 [Bio-4]), and under Section 2.3.4.9 (Human Health and Safety).

2.5 No-Action Alternative

The CEQ regulations require the inclusion of a No-Action Alternative in an EA. The No-Action Alternative serves as a baseline against which the impacts of the Proposed Action can be evaluated.

Under the No-Action Alternative, the current launch processes would continue without using the boost-back capabilities of the Falcon 9 Full Thrust First Stage or autonomous flight termination system. Depending on the trajectory of the launch vehicle, the First Stage would drop into the Pacific Ocean approximately 300–500 mi. (480–800 km; Figure 2-15) west of the Baja California coast (in all launch azimuth directions). The First Stage is not recoverable due to previous attempts at recovering First Stages during boost-back attempts at sea. The First Stage would subsequently sink and therefore, would not be recovered. The potential impacts of the No Action Alternative have been previously analyzed in the *Final Environmental Assessment Falcon 9 and Falcon 9 Heavy Launch Vehicle Programs from Space Launch Complex 4 East Vandenberg Air Force Base, California* (U.S. Air Force 2011a).

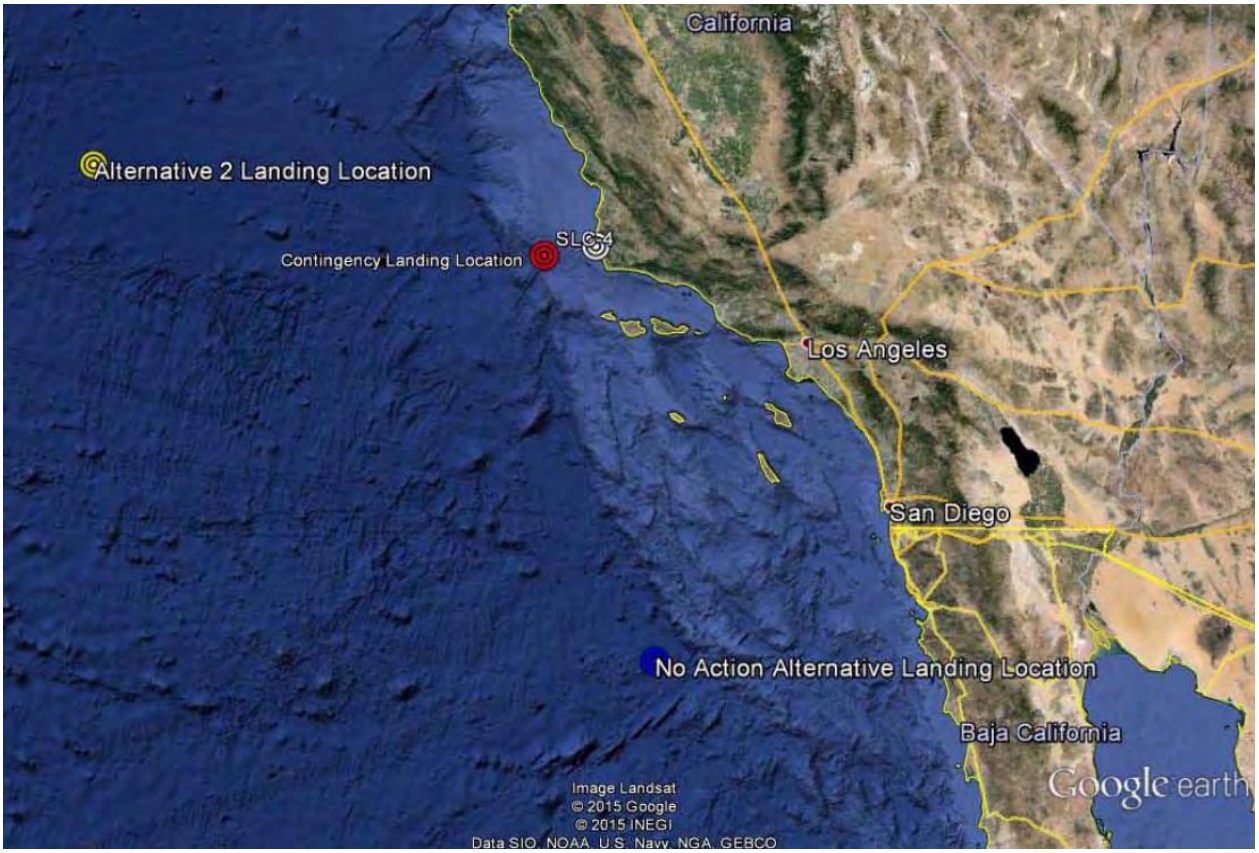

Figure 2-15. Alternative 2 and No Action Alternative Landing Locations

Although propellants would be burned to depletion during flight, there is a potential for a minimum amount of LOX and RP-1 to remain in the expended Falcon 9 Full Thrust First Stage. The tanks would explode upon impact; thus, remaining LOX and RP-1 would be burned.

The No Action alternative would negatively affect SpaceX's ability to satisfy the USAF and NASA requirements under the SAA to continue to support the U.S. goal of encouraging activities by enhancing operational efficiency and reduce launch costs by investing in the modernization of space launch infrastructure.

2.6 Other Alternatives Considered and Eliminated from Further Analysis

Other alternatives were considered for this action but were determined to be impracticable to meet the underlying purpose and need of the Proposed Action, as described below.

One alternative that was considered was the utilization of the undeveloped SLC-7 site. The location would have resulted in potentially extensive disturbance to a previously undisturbed area, thereby potentially resulting in a greater environmental impact to various resources. This would have included the improvement and surfacing of a dirt road, construction of a new access road, and installation of utilities including fiber optic pathways for internet over long distances to meet up with existing utility tie-ins. In addition, post-landing processing of the Falcon 9 rocket would require transportation back to SLC-4E. This alternative would not allow SpaceX to meet its launch schedule, as development of this site would be several years away due to more extensive

regulatory requirements. Therefore, this alternative was eliminated for not meeting Criteria 5, 6, 8, and 9.

A contingency landing action on the water (rather than on a drone ship) 31 mi. (50 km) offshore at the contingency landing location was also considered but not carried forward due to significant environmental impacts. USFWS concurrence that a water landing may affect but was not likely to adversely affect ESA-listed species under the jurisdiction of the USFWS was received (2015-I-0208; Appendix D); however, the contingency water landing was subsequently removed from the project due to potentially significant effects on species protected under the jurisdiction of NOAA Fisheries. If a water landing is proposed in the future, it would require further environmental analysis under NEPA.

The use of the VAFB Harbor for offloading the First Stage after a contingency landing was considered; however, vessel traffic in this location would have potential impacts to the federally listed southern sea otter. As a result, SpaceX did not pursue this alternative to avoid these potential impacts. Utilization of the VAFB Harbor was eliminated from further analysis since it did not meet Criterion 9.

No other reasonable alternatives were identified and carried forward.

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3 Affected Environment

This chapter describes the existing environment near and within the project area for Alternative 1 (Proposed Action), Alternative 2, and the No-Action Alternative. The area considered for most resources was the immediate area of the proposed construction (SLC-4W) and the areas potentially impacted by overpressure, landing noise, and the overflight path. For some environmental resources, a wider regional area was evaluated.

The resources identified for analysis in this EA include air quality, noise (airborne), biological resources, water resources, cultural resources, geology and earth resources, human health and safety, hazardous materials and waste management, solid waste management, land use and aesthetics, coastal zone management, transportation, Section 4(f) properties, and utilities. The resources identified for analysis for implementation of the AFSS only include human health and safety. The following resources were considered but not analyzed in this EA:

- ***Environmental Justice***. Per EO 12898, *Federal Actions to Address Environmental Justice in Minority Populations and Low-Income Populations*, the potential effects of the Proposed Action on minority communities and low-income communities were considered. The project would neither affect nor disproportionately affect low-income or minority populations within the region of influence (Lompoc and Santa Maria Valleys). The Proposed Action would occur within an unpopulated area of VAFB, and potential environmental impacts with the exception of noise would not extend into populated areas. With regard to potential impacts from noise, given the short duration (typically 60 seconds) of the landing noise and the relatively low received noise levels at sensitive receptors, the contribution of launch noise would be minimal, and it is unlikely that DNL levels would be elevated as a result of a single landing event. Additionally, noise impacts would be less than the impacts from the launch of the vehicle, which have previously been analyzed as having less than significant impacts to the noise environment (U.S. Air Force 2011a) and, thus, less than significant impacts to minority communities and low-income communities.
- ***Socioeconomics.*** Implementing the Proposed Action could result in the creation of some temporary new jobs. Temporary jobs may be created from new construction for the SLC-4W landing pad. Once construction is complete, operation of the facility would be conducted by existing SpaceX staff and its subcontractors. However, any potential new jobs would not have a significant effect on the socioeconomic environment of the region (Lompoc Valley and Santa Maria Valley) and no substantial change to economic factors from the Proposed Action is expected.
- ***Recreation.*** Access to VAFB is controlled by the USAF. Military personnel can utilize portions of South VAFB for general outdoor recreation; however, public access to the South VAFB and the vicinity of SLC-4W is not allowed for general outdoor recreation. Surf Beach, Wall Beach, County of Santa Barbara Ocean Beach Park, Jalama Beach County Park, and Miguelito Park, however, are open to the public. During launches from SLC-4E, access to these parks is restricted. The boost-back and landing of the First Stage would happen

immediately after a launch from SLC-4E, if the First Stage is returned to SLC-4W. Therefore, restrictions are already in place as a result of the launch, and the Proposed Action would not require any additional restrictions on access to these parks and beaches for recreation.

Recreational boating and fishing occurs offshore of VAFB, however the contingency landing location is sufficiently far from shore (31 mi. [50 km]) to make impacts to recreational boating unlikely. The U.S. Coast Guard would issue a Local Notice to Mariners that defines a Public Ship Avoidance Area for contingency landing events. The avoidance area would be temporary and lifted as soon as the U.S. Coast Guard determines it is safe to do so. Since potential impacts to recreational boating are unlikely (due to the distance from shore) and temporary (no permanent closures) and there are no new impacts to recreation on land, recreational resources are not assessed further in this EA.

- ***Floodplains.*** SLC-4W is outside of floodplains, and floodplains would not be affected by the Proposed Action; therefore, floodplains are not assessed in this EA.

3.1 Air Quality

3.1.1 Definition of Resource

Air quality is defined by ambient air concentrations of specific pollutants determined by the USEPA to be of concern with respect to the health and welfare of the general public. Six major pollutants of concern, called "criteria pollutants," are carbon monoxide (CO), sulfur dioxide (SO_2), nitrogen dioxide (NO_2), ozone (O_3), suspended particulate matter less than or equal to 10 microns in diameter (PM_{10}), fine particulate matter less than or equal to 10 microns in diameter ($PM_{2.5}$), and lead (Pb). The USEPA has established National Ambient Air Quality Standards (NAAQS) for these pollutants. Areas that violate a federal air quality standard are designated as non-attainment areas.

Ambient air quality refers to the atmospheric concentration of a specific compound (amount of pollutants in a specified volume of air) that occurs at a particular geographic location. The ambient air quality levels measured at a particular location are determined by the interactions of emissions, meteorology, and chemistry. Emission considerations include the types, amounts, and locations of pollutants emitted into the atmosphere. Meteorological considerations include wind and precipitation patterns affecting the distribution, dilution, and removal of pollutant emissions. Chemical reactions can transform pollutant emissions into other chemical substances. Ambient air quality data are generally reported as a mass per unit volume (e.g., micrograms per cubic meter of air) or as a volume fraction (e.g., parts per million [ppm] by volume).

Pollutant emissions typically refer to the amount of pollutants or pollutant precursors introduced into the atmosphere by a source or group of sources. Pollutant emissions contribute to the ambient air concentrations of criteria pollutants, either by directly affecting the pollutant concentrations measured in the ambient air or by interacting in the atmosphere to form criteria pollutants. Primary pollutants, such as CO, SO_2, lead, and some particulates, are emitted directly into the atmosphere from emission sources. Secondary pollutants, such as O_3, NO_2, and some particulates, are formed through atmospheric chemical reactions that are influenced by

meteorology, ultraviolet light, and other atmospheric processes. PM_{10} and $PM_{2.5}$ are generated as primary pollutants by various mechanical processes (for example, abrasion, erosion, mixing, or atomization) or combustion processes. However, PM_{10} and $PM_{2.5}$ can also be formed as secondary pollutants through chemical reactions or by gaseous pollutants condensing into fine aerosols. In general, emissions that are considered "precursors" to secondary pollutants in the atmosphere (such as reactive organic gases (ROG) and NO_x, which are considered precursors for O_3), are the pollutants for which emissions are evaluated to control the level of O_3 in the ambient air.

The State of California has identified four additional pollutants for ambient air quality standards: visibility reducing particles, sulfates, hydrogen sulfide, and vinyl chloride. The CARB has also established the more stringent California Ambient Air Quality Standards (CAAQS). Areas within California in which ambient air concentrations of a pollutant are higher than the state or federal standard are considered to be non-attainment for that pollutant. Table 3-1 shows both the federal and state ambient air quality standards.

Toxic air pollutants, also called hazardous air pollutants, are a class of pollutants that do not have ambient air quality standards but are examined on an individual basis when there is a source of these pollutants. The State of California has identified particulate emissions from diesel engines as a toxic air pollutant.

Global temperatures are moderated by naturally occurring atmospheric gases, including water vapor, carbon dioxide (CO_2), methane (CH_4) and nitrous oxide (N_2O), which are known as greenhouse gases (GHGs). These gases allow solar radiation (sunlight) into the Earth's atmosphere, but prevent radiative heat from escaping, thus warming the Earth's atmosphere. Gases that trap heat in the atmosphere are often called GHGs, analogous to a greenhouse. GHGs are emitted by both natural processes and human activities. State law defines GHGS as any of the following compounds: CO_2, CH_4, N_2O, hydrofluorocarbons (HFCs), perfluorocarbons, and sulfur hexafluoride (SF_6) (California Health and Safety Code Section 38505(g)). GHGs have varying global warming potential (GWP). The GWP is the potential of a gas or aerosol to trap heat in the atmosphere; it is the "measure of the total energy that a gas absorbs over a particular period of time (usually 100 years), compared to CO_2" (U.S. Environmental Protection Agency 2013). The reference gas for GWP is CO_2; therefore, CO_2 has a GWP of 1. The other main GHGs that have been attributed to human activity include CH_4, which has a GWP of 21, and N_2O, which has a GWP of 310. CO_2, followed by CH_4 and N_2O, are the most common GHGs that result from human activity. CO_2, and to a lesser extent, CH_4 and N_2O, are products of combustion and are generated from stationary combustion sources as well as vehicles. High global warming potential gases include GHGs that are used in refrigeration/cooling systems such as chlorofluorocarbons and hydrofluorocarbons.

Table 3-1. Ambient Air Quality Standards

Pollutant	Averaging Time	NAAQS[1]		CAAQS[2]
		Primary[3]	Secondary[4]	Concentration[5]
Ozone (O_3)	1-Hour	-	Same as Primary Standard	0.09 ppm (180 µg/m^3)
	8-Hour	0.070 ppm		0.070 ppm (137 µg/m^3)[7]
Respirable Particulate Matter (PM_{10})	24-Hour	150 µg/m^3	Same as Primary Standard	50 µg/m^3
	Annual Arithmetic Mean	-		20 µg/m^3
Fine Particulate Matter ($PM_{2.5}$)	24-Hour	35 µg/m^3	Same as Primary Standard	-
	Annual Arithmetic Mean	12.0 µg/m^3	15 µg/m^3	12 µg/m^3
Carbon Monoxide (CO)	8-Hour	9 ppm (10 µg/m^3)	None	9.0 ppm (10 µg/m^3)
	1-Hour	35 ppm (40 µg/m^3)		20 ppm (23 µg/m^3)
Nitrogen Dioxide (NO_2)	Annual Average	0.053 ppm (100 µg/m^3)	Same as Primary Standard	0.030 ppm (56 µg/m^3)
	1-Hour	0.100 ppm (188 µg/m^3)		0.18 ppm (338 µg/m^3)
Sulfur Dioxide (SO_2)	Annual Arithmetic Mean	0.030 ppm	-	-
	24-Hour	0.14 ppm	-	0.04 ppm (105 µg/m^3)
	3-Hour	-	1300 µg/m^3 (0.5 ppm)	-
	1-Hour	75 ppb (196 µg/m^3)	-	0.25 ppm (655 µg/m^3)
Lead (Pb)[6]	30-Day Average	-	-	1.5 µg/m^3
	Calendar Quarter	1.5 µg/m^3	Same as Primary Standard	-
	3-Month Rolling Average	0.15 µg/m^3	Same as Primary Standard	-
Hydrogen Sulfide (HS)	1-Hour	No Federal Standards		0.03 ppm (42 µg/m^3)
Sulfates (SO_4)	24-Hour			25 µg/m^3
Visibility Reducing Particles	8-Hour (10 am to 6 pm, Pacific Standard Time)			In sufficient amount to produce an extinction coefficient of 0.23 per km due to particles when the relative humidity is less than 70 percent.
Vinyl chloride[6]	24 Hour			0.01 ppm (26 µg/m^3)

[1] NAAQS (other than O_3, particulate matter, and those based on annual averages or annual arithmetic mean) are not to be exceeded more than once a year. The O_3 standard is attained when the fourth highest 8-hour concentration in a year, averaged over 3 years, is equal to or less than the standard. For PM_{10}, the 24-hour standard is attained when 99 percent of the daily concentrations, averaged over 3 years, are equal to or less than the standard. For $PM_{2.5}$, the 24-hour standard is attained when 98 percent of the daily concentrations, averaged over 3 years, are equal to or less than the standard. Contact the USEPA for further clarification and current federal policies.

[2] California Ambient Air Quality Standards for O_3, CO (except Lake Tahoe), SO_2 (1- and 24-hour), NO_2, PM_{10}, and visibility reducing particles, are values that are not to be exceeded. All others are not to be equaled or exceeded.

[3] National Primary Standards: The levels of air quality necessary, with an adequate margin of safety, to protect the public health.

[4] National Secondary Standards: The levels of air quality necessary to protect the public welfare from any known or anticipated adverse effects of a pollutant.

[5] Concentration expressed first in units in which it was promulgated. Ppm in this table refers to ppm by volume or micromoles of pollutant per mole of gas.

[6] The CARB has identified lead and vinyl chloride as "toxic air contaminants" with no threshold level of exposure for adverse health effects determined. These actions allow for the implementation of control measures at levels below the ambient concentrations specified for these pollutants.

Notes: ppm = part(s) per million, µg/m^3 = milligrams per cubic meter

Source: California Air Resources Board 2015

3.1.2 Regional Setting

VAFB is within Santa Barbara County and under the jurisdiction of the SBCAPCD. The SBCAPCD is the agency responsible for the administration of federal and state air quality laws, regulations, and policies in Santa Barbara County, which is within the South Central Coast Air Basin (SCCAB). The SCCAB includes San Luis Obispo, Santa Barbara, and Ventura Counties.

The SCCAB, and all of Southern California, lies in a semi-permanent high-pressure zone of Eastern Pacific Region. The coastal island is characterized by sparse rainfall, most of which occurs in the winter season and hot, dry summers, tempered by cooling sea breezes. In Santa Barbara County, the months of heaviest precipitation are November through April, averaging 14.66 inches annually. The mean temperature in the VAFB area, as reported by monitors in Lompoc, is 58.3°F and the mean maximum and mean minimum temperatures are 69.6°F and 47.0°F, respectively (Western Regional Climatic Center 2015).

Santa Barbara County is classified as an attainment/unclassified area for the NAAQS for all criteria pollutants. Santa Barbara County is considered a nonattainment area for the CAAQS for ozone and PM_{10}. Santa Barbara County is classified as an attainment/unclassified area for the CAAQS for all other criteria pollutants.

The CARB and SBCAPCD operate a network of ambient air monitoring stations throughout Santa Barbara County. The purpose of the monitoring stations is to measure ambient concentrations of the pollutants and determine whether the ambient air quality meets the CAAQS and the NAAQS. The nearest ambient monitoring stations to the project site are the VAFB STS Power site and the Lompoc S. H Street monitoring station. The VAFB monitoring station measures O_3, PM_{10}, CO, NO_2, and SO_2, but does not measure $PM_{2.5}$. The station ceased monitoring CO in 2012, as CO levels have been well below the state and federal standards. The Lompoc S. H Street monitoring station measures all criteria pollutants.

Table 3-2 presents a summary of ambient air quality measurements for the period from 2011 to 2013. The 1-hour CAAQS for ozone was not exceeded at the VAFB monitoring station during the period from 2011 through 2013. The 8-hour CAAQS for ozone was exceeded once in 2013. The Vandenberg station measured one exceedance of the 1-hour NO_2 standard in 2013; however, the standard is not based on a single exceedance and the region remains unclassified/attainment. The 24-hour CAAQS for PM_{10} was exceeded at the Vandenberg station in 2011 and again in 2013. The data from the monitoring stations indicate that air quality is in attainment of all other state and federal standards. Exceeding CAAQS standards may result in additional mitigation requirements, as described in Section 4.1 (Air Quality). If emissions were to exceed a significance threshold, further analysis of the emissions and their potential consequences may be performed to assess the likelihood of a significant impact to air quality. The nature and extent of such analysis would depend on the specific circumstances. The analysis could range from a more detailed and precise examination of the activities and equipment resulting in the greatest contribution to emissions, to air dispersion modeling analyses.

Table 3-2. Background Ambient Air Quality at VAFB (concentrations in ppm unless otherwise indicated)

Pollutant	Averaging Time	2011	2012	2013	CAAQS (ppm)	NAAQS (ppm)	Monitoring Station
Ozone	8 hour	0.067	0.062	0.071	0.070	0.075*	Vandenberg
	1 hour	0.079	0.069	0.074	0.09	-	Vandenberg
PM_{10}	Annual Arithmetic Mean	17.9 µg/m^3	15.9 µg/m^3	19.9 µg/m^3	20 µg/m^3	-	Vandenberg
	24 hour	54.0 µg/m^3	47.0 µg/m^3	57.6 µg/m^3	50 µg/m^3	150 µg/m^3	Vandenberg
$PM_{2.5}$	Annual Arithmetic Mean	7.5 µg/m^3	N/A	N/A	12 µg/m^3	12.0 µg/m^3	Lompoc
	24 hour	18.8 µg/m^3	18.1 µg/m^3	15.9 µg/m^3	-	35 µg/m^3	Lompoc
NO_2	Annual	0.001	0.000	0.000	0.030	0.053	Vandenberg
	1 hour	0.012	0.013	0.130	0.18	0.100	Vandenberg
CO	8 hour	0.30	0.41	N/A	9.0	9	Vandenberg
SO_2	Annual	0.000	0.000	0.000	-	0.030	Vandenberg
	24 hour	0.002	0.003	0.001	0.04	0.14	Vandenberg

California averages reported for PM_{10}
N/A = not available from current website data
Source: www.arb.ca.gov
Notes: CAAQS = California Ambient Air Quality Standards, CO = Carbon Monoxide, NAAQS = National Ambient Air Quality Standards, NO_2 = Nitrogen Dioxide, $PM_{2.5}$ = Particulate Matter less than 2.5 microns, PM_{10} = Particulate Matter less than 10 microns, ppm = part(s) per million, µg/m^3 = microgram(s) per cubic meter, * The federal standard was revised to .070 ppm in 2015.

3.1.3 Region of Influence

Specifically identifying the region of influence (ROI) for air quality requires knowledge of the type of pollutant, emission rates of the pollutant source, proximity to other emission sources, and local and regional meteorology. For inert pollutants (all pollutants other than ozone and its precursors), the ROI is generally limited to a few miles downwind from the source. However, for photochemical pollutant such as ozone, the ROI may extend much farther downwind. Ozone is a secondary pollutant that is formed in the atmosphere by photochemical reactions of previously emitted pollutants, or precursors (ROG, NO_x, and PM_{10}). The maximum effect of precursors on ozone levels tends to occur several hours after the time of emission during periods of high solar load and may occur many miles from the source. Ozone and ozone precursors transported from other regions can also combine with local emissions to produce high local ozone concentrations. The ROI for the Proposed Action includes the SCCAB.

3.1.4 Federal Requirements

The USEPA is the agency responsible for enforcing the Clean Air Act (CAA) of 1970 and its 1977 and 1990 amendments. The purpose of the CAA is to establish NAAQS, to classify areas as to their attainment status relative to the NAAQS, to develop schedules and strategies to meet the NAAQS, and to regulate emissions of criteria pollutants and air toxics to protect public health and welfare. Under the CAA, individual states are allowed to adopt ambient air quality standards and other regulations, provided they are at least as stringent as federal standards. The Clean Air Act Amendments (CAAA) (1990) established new deadlines for achievement of the NAAQS, dependent upon the severity of non-attainment.

The USEPA requires each state to prepare a State Implementation Plan (SIP), which describes how that state will achieve compliance with the NAAQS. A SIP is a compilation of goals, strategies,

schedules, and enforcement actions that will lead the state into compliance with all federal air quality standards.

The CAAA also require that states develop an operating permit program that would require permits for all major sources of pollutants. The program would be designed to reduce mobile source emissions and control emissions of hazardous air pollutants through establishing control technology guidelines for various classes of emission sources.

New Source Review: A New Source Review (NSR) is required when a source has the potential to emit any pollutant regulated under the CAA in amounts equal to or exceeding specified major source thresholds (100 or 250 tons per year) which are predicated on a source's industrial category. Through the SBCAPCD's permitting processes, all stationary sources are reviewed and are subject to an NSR process.

Executive Order 13693: This EO, *Planning for Federal Sustainability in the Next Decade*, was signed by President Obama on 19 March 2015. The EO sets a goal of reducing Federal agency GHG emissions by 40 percent over the next decade. The EO sets agency GHG reduction targets and sustainability goals, and requires the head of each Federal agency to propose to the Chair of the CEQ and the Director of the Office of Management and Budget percentage reduction targets for agency-wide reductions of scope 1 and 2 and scope 3 GHG emissions in absolute terms by the end of fiscal year 2025 relative to a fiscal year 2008 baseline. The EO sets sustainability goals for Federal agencies.

General Conformity: Under 40 C.F.R. Part 93 and the provisions of Part 51, Subchapter C., Chapter I, Title 40, Appendix W of the C.F.R., of the CAA as Amended, federal agencies are required to demonstrate that federal actions conform with the applicable SIP. The USEPA general conformity rule applies to federal actions occurring in non-attainment or maintenance areas. Because Santa Barbara County is an unclassified/attainment area for all NAAQS, the General Conformity Rule does not apply to the Proposed Action at VAFB.

3.1.5 Local Requirements

As indicated previously, in Santa Barbara County, the SBCAPCD is the agency responsible for the administration of federal and state air quality laws, regulations, and policies. Included in the local air districts' tasks are monitoring of air pollution, maintenance of air quality standards through programs to control air pollutant emissions, and the promulgation of Rules and Regulations.

SBCAPCD regulations require that facilities building, altering, or replacing stationary equipment that may emit air pollutants obtain an Authority to Construct permit. Further, SBCAPCD regulations require a stationary source of air pollutants to obtain a Permit to Operate. The local air districts are responsible for the review of applications and for the approval and issuance of these permits. SpaceX anticipates that the Proposed Action would not require any stationary sources. In addition, the SBCAPCD regulations require a stationary source that would emit 25 tons per year or more of any pollutant except CO in any calendar year during construction to obtain emission offsets.

On 30 April 2015, the SBCAPCD adopted revisions to their Environmental Review Guidelines to the California Environmental Quality Act (CEQA) by adding significance thresholds for GHG

cumulative impacts. The District has adopted a screening threshold of 10,000 metric tons of carbon dioxide equivalents (CO_2e) per year. As a lead agency, the SBCAPCD is required to address the cumulative impacts of GHG emissions from the project as part of their CEQA review during the permitting process, should permits be mandated. Should emissions exceed the screening threshold, mitigation measures could be required to reduce emissions of GHGs.

3.2 Sound (Airborne)

3.2.1 Region of Influence

This section addresses potential noise impacts on the human environment in the vicinity of VAFB from noise generated by activities identified in the alternatives, including the Proposed Action. For the purpose of this EA, the ROI for Alternative 1 (Proposed Action) includes the SLC-4 complex and areas potentially overflown by the First Stage vehicle landing at SLC-4W, the contingency landing area 31 mi. (50 km) offshore, areas that may be impacted by landing noise, and areas that may be impacted by a sonic boom as illustrated in Figures 2-4, 2-5, 2-6, 2-9, 2-10, and 2-11.

3.2.2 Sound Characteristics

Sound results from vibrations, introduced into a medium such as air, that stimulate the auditory nerves of a receptor to produce the sensation of hearing. Sound is undesirable if it interferes with communication, is intense enough to damage hearing, or diminishes the quality of the environment. Undesirable sound is commonly referred to as “noise.” Human responses to sound vary with the types and characteristics of the sound source, the distance between the source and receptor, receptor sensitivity, the background sound level, and other factors such as time of day. Sound may be intermittent or continuous, steady or impulsive, and may be generated by stationary sources such as industrial plants or transient noise sources such as cars and aircraft. Sound energy travels in waves. Its intensity at a receptor varies as a function of source intensity, the characteristics of the sound wave, the distance between source and receiver, and environmental conditions. Reflection, refraction, diffraction, and absorption are physical interactions between sound waves and surfaces or the medium through which the sound travels.

Most environments include near-constant, long-term sound sources that create a background sound level, and intermittent, intrusive sources that create sound peaks that are noticeably higher than the background levels. In remote areas far away from any human activities, the background sound level is determined by natural sources such as water (e.g., rain), and wind blowing through the vegetation. The extent to which an intrusive sound affects a given receptor in the environment depends upon the degree to which the intruding sound exceeds the background sound level. Both background and intrusive sound may affect the quality of life in a given environment. Cumulative, long-term exposure to excessive background sound is recognized as the primary cause of hearing loss. Intrusive sound, although not a cause of permanent hearing loss, can contribute to stress, irritability, loss of sleep, and impaired work efficiency.

Impulsive sound is short in duration, less than 1 second, and high in intensity. Impulsive sound has an abrupt onset and decays rapidly; it is characteristic of sonic booms, and is expressed in

peak, unweighted decibels (dBP; defined in Section 3.2.3, Sound Spectrum) or pressure psf. Although impulsive sound is short in duration, it may be a source of discomfort for many people as the rapid onset of sound may produce a "startle" effect (U.S. Department of the Navy 1978).

3.2.3 Sound Spectrum

Sound oscillates in waves, and the rates of oscillation (frequencies) are measured in cycles per second, or Hz. The human ear can detect sounds ranging in frequency from about 20 to 20,000 Hz, with the ear most sensitive to frequencies from 1,000 to 4,000 Hz (U.S. Army 2005). Most environmental sounds consist not of a single frequency, but rather a broad band of frequencies that vary in intensity. Sound frequencies from military training activities vary greatly. Some examples of frequencies at peak sound energy include fixed-wing aircraft (2,000–4,000 Hz), small arms (approximately 500 Hz), explosives (approximately 31 Hz), street vehicles (approximately 60 Hz), and diesel trucks (approximately 250 Hz) (U.S. Department of the Navy 1978; U.S. Army 2005). The human ear is not equally sensitive to all sound frequencies within the frequency range of human hearing; the human ear cannot detect lower frequencies as well as it can detect higher frequencies. Thus, the "raw" sound intensity measured by mechanical devices is selectively weighted—or filtered—to simulate the non-linear response of the human ear. The two typical weighting networks are the C scale and the A scale (Figure 3-1).

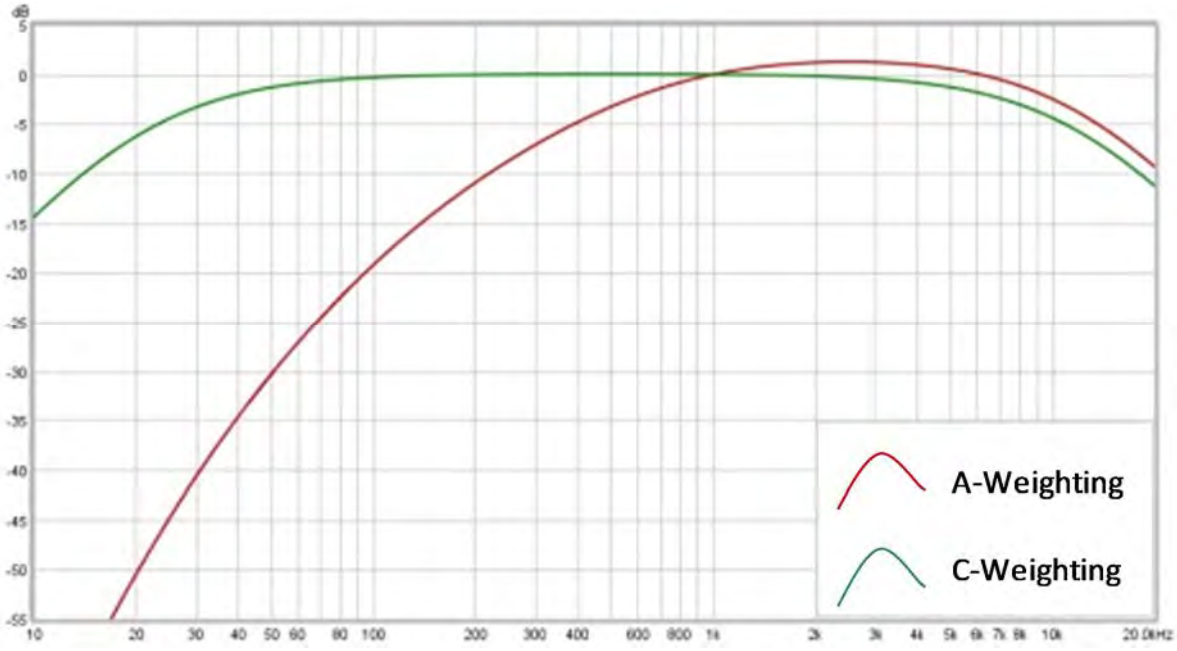


Figure 3-1. A and C Weighting Scales

Weighting networks are used in sound meters to adjust their frequency response to "raw" (unweighted) measured sounds. The A-weighting network is designed to duplicate the sensitivity of the human ear, heavily discounting sound energy at low frequencies and at very high frequencies and corresponding roughly to the average sensitivity of the human ear at low to moderate sound levels. In several studies, a person's judgment of the loudness of a sound has been shown to correlate well with the A-weighted values of those sounds (U.S. Department of the Navy 1978). For this reason, the A scale is the most common weighting scheme for

community sound measurements and standards, and is used for most environmental noise evaluations. These adjusted sound levels are termed "A-weighted" sound levels, denoted as dB(A) or simply dBA. The A-weighted scale is used internationally in sound standards and regulations. Therefore, dBA is the primary sound metric to be used in analyzing sound effects under environmental consequences because its characteristics are reflective of the human ear's frequency response.

3.2.4 Sound Metrics

Transient sound is defined as an "event having a beginning and an end where the sound temporarily rises above the background and then fades into it" (U.S. Army 2005). These types of sounds, measured in terms of Sound Exposure Level (SEL), are associated with vehicles driving by, aircraft overflights, or impulse noise. The SEL is based on two characteristics of transient sound, duration and intensity, where a long duration, low-intensity event can be as annoying as a high-intensity, shorter event. The SEL is the total acoustic energy in an event normalized to 1 second (U.S. Army 2005). This number represents all of the acoustic energy for the event in a 1-second period.

A continually varying sound level over a given period can be described as a single "equivalent" sound level (L_{eq}) that contains an amount of sound energy equal to that of the actual sound level. As shown in the top panel of Figure 3-2, the sound level varies over time and increases during a sound "event" (in this case, an aircraft overflight). Thus, the L_{eq} is a measure of the average acoustic energy over a stated period, which includes both quiet periods and sound events. Equivalent sound levels can represent any length of time, but typically are associated with some meaningful period, such as an 8-hour L_{eq} for an office, or a 1-hour L_{eq} for a classroom lecture (U.S. Army 2005). The L_{eq} is often averaged over a 1-, 8-, or 24-hour period. The L_{eq} is used to describe continuous sound sources, and may be obtained by averaging sound levels over a selected period. This level is the estimation of the continuous sound level that would be equivalent to the fluctuating sound signal under consideration (U.S. Department of the Navy 1978). A L_{eq} that is a 24-hour average can also be termed the Day-Night Average Sound Level (DNL), with a caveat. The DNL is the average noise level over a 24-hour period (as shown in the bottom panel of Figure 3-2; this represents the average of 24 1-hour L_{eq} values). However, the noise between the hours of 10 p.m. and 7 a.m. is artificially increased by dB. This noise is weighted to take into account the decrease in community background noise of 10 dB during this period (Figure 3-2).

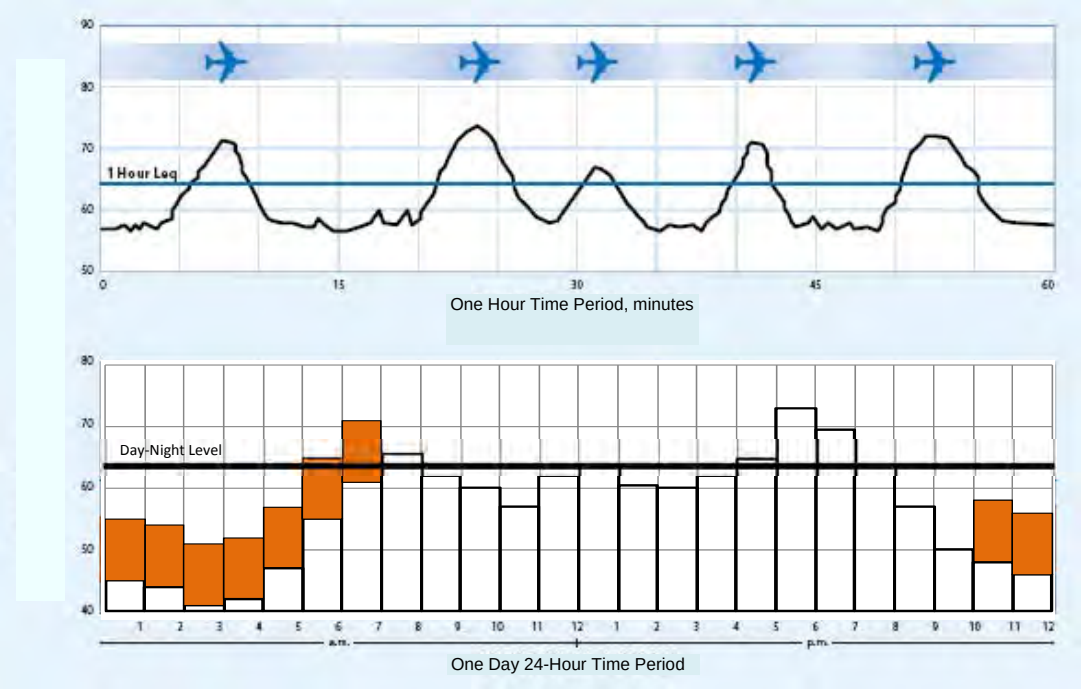


Figure 3-2. Relationship of Sound Level, L_{eq}, and Day-Night Average Sound Level

3.2.5 Sound Intensity and Perception

Sound intensity is expressed in dB, a logarithmic scale that compares the power of an acoustical signal to a reference power level. A sound level of 0 dB is defined as the threshold of human hearing. The quietest environmental conditions yield sound levels of about 20 dBA. Typical nighttime sound levels in quiet residential areas have a sound level of about 35–45 dBA. Normal speech has a sound level of about 60 dBA at a distance of about 3.3 ft. (1 m). A freight train passing by at about 49.2 ft. (15 m) yields a sound level of about 85 dBA. The human pain threshold is about 120 dBA (Table 3-3).

A 1 dB change in the sound level is not perceptible to humans (imperceptible change), a 3 dB change is barely perceptible, and a 5 dB change is clearly noticeable. A 10 dB change is perceived by the human ear as a doubling or halving in loudness.

Table 3-3. Sound Levels of Selected Sound Sources and Environments

Source	Sound Level (dBA)	Human Perception of Loudness (relative to 70 dBA)
Military Jet Takeoff w/ afterburner at 50 ft. (15.2 m), Civil Defense Siren Falcon 9 Takeoff at 1,600 ft. (487m)	130	**Above Threshold of Pain**
Commercial Jet Takeoff at 200 ft. (61 m) Falcon 9 Takeoff at 2,500 ft. (762 m)	120	**Threshold of Pain** 32 times as loud
Pile Driver at 50 ft. (15.2 m) Falcon 9 takeoff at 1.5 mi. (2.4 km)	110	16 times as loud
Ambulance Siren at 100 ft. (30.5 m) Power Lawn Mower at 3 ft. (0.9 m)	100	**Very Loud** 8 times as loud
Motorcycle at 25 ft. (7.6 m) Propeller Plane at 1,000 ft. (304.8 m)	90	4 times as loud
Garbage Disposal at 3 ft. (0.9 m) Passenger car, 65 mph at 25 ft. (7.6 m)	80	2 times as loud
Vacuum Cleaner at 3 ft. (0.9 m) Living Room Stereo at 15 ft. (4.6 m)	70	**Moderately Loud** (Reference Loudness)
Normal Conversation at 5 ft. (1.5 m)	60	1/2 as loud
Light Traffic at 100 ft. (30.5 m)	50	1/4 as loud
Distant Bird Calls	40	**Quiet** 1/8 as loud
Soft Whisper at 5 ft. (1.5 m)	30	1/16 as loud
	0	**Threshold of Hearing**

Notes: dBA = decibel(s), A-weighted; ft. = foot/feet; m = meter(s); mi. = mile(s); mph = miles per hour

Sources: Federal Interagency Committee on Noise 1992, U.S. Army 2005, U.S. Air Force 2013b

3.2.6 Sound Propagation

Sound energy radiates outward from its source. This sound energy attenuates (decreases in intensity) as it moves away from its source because of geometric spreading of the sound energy, atmospheric absorption, ground attenuation, and shielding. Sound metrics for discrete sources are expressed in terms of a distance from the source (a typical reference distance is 50 ft. [15.2 m]).

Sound waves from point sources radiate in a spherical pattern, with the wave intensity attenuating due to geometric spreading by 6 dB per doubling of distance from the source (U.S. Army 2005). Line sources such as roads generate composite sound waves from numerous moving point sources that radiate outward in parallel planes; these waves attenuate due to geometric cylindrical spreading by only 3 dB per doubling of distance.

At substantial distances from the source, air absorption and ground attenuation can affect sound propagation. The efficiency of atmospheric absorption varies over the range of sound frequencies. At frequencies around 2,000 Hz, air absorption is about 20 dB per km. At 1,000 Hz, it is about 7 dB per km. At frequencies below 125 Hz, it is less than 1 dB per km. Factors for ground attenuation and barrier attenuation likewise vary by frequency. In practice, empirical

determinations of sound attenuation (i.e., measuring the actual source in its proposed location) are best able to account for all possible factors.

3.2.7 Time-Averaged Sound Levels

Ambient sound standards regulate ambient sound levels through time-averaged sound L_{eq} limits. Sound standards for land use compatibility established by DoD and civilian jurisdictions are expressed in terms of the DNL. Based on numerous sociological surveys and recommendations of federal interagency councils, the most common benchmark for assessing environmental sound impacts is a DNL of 65 dBA (Schomer 2005; Federal Interagency Committee on Noise 1992). Sound levels up to 65 dBA DNL are considered to be compatible with land uses such as residences, transient lodging, and medical facilities.

Existing noise levels on VAFB are generally quite low due to the large areas of undeveloped landscape and relatively sparse noise sources. Background noise levels are primarily driven by wind noise; however, louder noise levels can be found near industrial facilities and transportation routes. On VAFB, general ambient one-hour average sound level (L_{eq1H}) measurements have been found to range from around 35 to 60 dB (Thorson et al. 2001). Rocket launches and aircraft overflights create louder intermittent noise levels, which do not generally impact hourly noise levels offshore, while ambient in-air noise levels are driven primarily by wind and wave noise.

Noise levels in the adjacent city of Lompoc, are primarily driven by transportation noise and regional aircraft activities. Depending on regional airport activity, DNLs are typically between 55 and 65 dBA (City of Lompoc 2014b).

3.2.8 Ambient Sound Guidance Documents

- 49 U.S.C. 40101 et seq., as amended by Public Law (PL) 103–305 (23 August 1994) (The Federal Aviation Act of 1958). This act is the basic aviation policy and has been amended often since 1958. In its original provisions the Act gave the FAA responsibility for all aspects of aviation but did not specifically authorize the FAA to establish noise abatement rules.
- 49 U.S.C. 44715 (Controlling Aircraft Noise and Sonic Boom, 1968). Authorized the FAA to prescribe standards for the measurement of aircraft noise and to establish regulations to abate noise.
- 42 U.S.C. 4901 (The Noise Control Act [NCA] of 1972, as amended). This act amended the Federal Aviation Act and the Aircraft Noise Abatement Act to involve the USEPA in the regulation of airport noise.
- FAA Order 1050.1 "Environmental Impacts: Policies and Procedures" Appendix A, Section 14 Noise.

3.2.9 Sensitive Receptors

Noise sensitive areas are those areas where noise interferes with normal activities associated with its use. Normally, noise sensitive areas include residential, educational, health, and religious structures and sites; parks; recreational areas (including areas with wilderness characteristics); wildlife refuges; and cultural and historical sites. Individuals and isolated, residential structures

may be considered compatible within the 65 dB DNL noise contour where the primary use of land is agricultural and adequate noise attenuation is provided (FAA Order 10501.E [paragraph 11(b)(8)]. Also, transient residential use such as motels may be considered compatible within the 65 dB DNL noise contour where adequate noise attenuation is provided. Users of designated recreational areas are considered sensitive receptors.

Noise sensitive land uses on and near VAFB include residential areas, hospitals, schools, and libraries. These sensitive receptors are located in the Cantonment Area of VAFB, which is located over 5 mi. (8 km) north of the project site. No sensitive receptors are located on or near the SLC-4 project site. There are numerous sensitive receptors in the City of Lompoc, including residential areas, hospitals, schools, parks, and libraries.

3.3 Biological Resources

The following biological resources are present and within the affected environment for the Proposed Action: vegetation resources (including special status plant species and communities), wildlife resources, special status wildlife species in the terrestrial portion of the project area, special status species in the marine portion of the project area (including fish, sea turtles, birds, and marine mammals), and sensitive marine habitats.

Under Section 7 of the ESA of 1973, as amended (16 U.S.C. 1531 et seq.), federal agencies are required to assess the effect of any project on species that are federally threatened, endangered, or proposed for listing based on the best scientific data available. Section 7 consultations with the USFWS and NOAA Fisheries are required for federal projects if such actions have the potential to directly or indirectly affect listed species, or destroy or adversely modify critical habitat.

It is also USAF policy to consider species listed by state agencies, and other federal special status species when evaluating the impacts of a project. In California, these include “fully protected” wildlife species, which are protected by the California Department of Fish and Wildlife (CDFW), per the California Fish and Game Code Sections 3511, 4700, 5050, and 5515. Although not subject to the requirements of the California Endangered Species Act (CESA), as a goal of its Integrated Natural Resource Management Plan (INRMP), VAFB also protects and conserves species considered sensitive by the state when not in direct conflict with the military mission.

The Marine Mammal Protection Act (MMPA) of 1972 (16 U.S.C. 1361 – 1407) restricts the taking of marine mammals, and its implementing regulations at 50 C.F.R. Part 216 prohibit the “taking” of any marine mammals. Taking includes injuring, killing, or harassing a marine mammal stock in the wild. The MMPA defines harassment as any act of pursuit, torment, or annoyance which has the potential to injure a marine mammal or marine mammal stock in the wild, or has the potential to disturb a marine mammal or marine mammal stock in the wild by causing disruption of behavioral patterns, including, but not limited to, migration, breathing, nursing, breeding, feeding, or sheltering. Implementation of the MMPA is a joint effort between NOAA Fisheries and USFWS. NOAA Fisheries is responsible for the management and conservation of cetaceans (whales and dolphins) and pinnipeds (seals and sea lions), while USFWS is responsible for southern sea otters.

The Fishery Conservation and Management Act (16 U.S.C. 1801–1882), as amended and reauthorized by the Magnuson-Stevens Fishery Conservation and Management Act, provides NOAA Fisheries legislative authority to regulate fisheries and protect important habitat through the creation of Essential Fish Habitat (EFH) as necessary habitat for fish spawning, breeding, feeding and growth to maturity.

VAFB is also subject to the requirements of the Migratory Bird Treaty Act (MBTA) of 1918 (16 U.S.C. 703-712) as amended, which protects native migratory birds, including their eggs, active nests, and young.

3.3.1 Region of Influence

The existing biological setting includes the regional setting of VAFB, the SLC-4W landing pad construction area, the contingency landing area 31 mi. (50 km) offshore, past and present disturbances in and near SLC-4W, and areas potentially impacted by sonic boom, landing noise, and noise of potential explosion (Figures 2-4, 2-5, 2-6, 2-9, 2-10, 2-11 and 2-14). Biological resources on VAFB are abundant and diverse compared to other areas of California because VAFB is within an ecological transition zone where the northern and southern ranges of many species overlap, and because the majority of the land within the base boundaries has remained undeveloped. Biological resources offshore are also diverse, including EFH and Biologically Important Areas (BIA) for cetaceans in the Western Region of the Pacific Coast (Calambokidis et al. 2015).

Responses to various aspects of the Proposed Action are dependent on the biology of the species and the overlap of their habitat use and occurrence with the potential impact and exposure zones of the expected environmental stressors (e.g., acoustic, visual, ground disturbance, etc.). Therefore, the ROIs for each biological resource will differ and are further defined in the subsections below.

3.3.2 Methodology

Impacts to biological resources were considered for all areas potentially impacted by construction, visual disturbance, direct impact, landing noise, and sonic boom. Prior special status species monitoring data, surveys, the California Natural Diversity Database (CNDDB), and Cetacean Density and Distribution Mapping Working Group (CetMap) records were consulted to assess the potential occurrence, distribution, and habitat use of special status species within the Action Area.

General biological surveys coupled with seacliff buckwheat (*Eriogonum parvifolium*) surveys and CRLF habitat assessments were conducted at SLC-4W on 11 March and 9 April 2014. The survey area included the SLC-4W complex and a 30 ft. buffer from the outer perimeter fence. To conduct surveys, two biologists walked meandering transects throughout the survey area and visually scanned for CRLF habitat and seacliff buckwheat and characterized vegetation types. Seacliff buckwheat stands were mapped using a Trimble Geo XT GPS unit. Vegetation types were mapped by hand using aerial photographs.

3.3.3 Vegetation Resources

The ROI for vegetation resources is the SLC-4W construction area where ground-disturbing activities would take place. Only non-native grassland (NNG), mixed central coast scrub (CCS), and "anthropogenic" habitat (areas already heavily impacted by prior construction and disturbance) occur within the area to be affected by proposed construction activities. Vegetation types are described in detail below. Where suitable, nomenclature follows Holland (1986).

3.3.3.1 Central Coast Scrub

This vegetation type is characterized by shallow-rooted, mesophylic plant species that are often drought-deciduous and summer-dormant. Past disturbances have facilitated the establishment of many non-native species such as iceplant within this vegetation type. The dominant native species in this habitat are California sagebrush (*Artemisia californica*) and coyote brush (*Baccharis pilularis*). Within the area to be affected by proposed construction activities, this vegetation type is fragmented and heavily infested with non-native grassland species forming a mixed CCS and NNG community.

3.3.3.2 Non-Native Grassland

This vegetation type occurs most commonly in areas that have been subjected to prior disturbance allowing weedy non-native species adapted to frequent disturbance to invade and dominate a site. Within the proposed construction area on SLC-4W this community consists of non-native forbs and grasses. Iceplant (*Carpobrotus edulis*) and veldt grass (*Ehrharta calycina*) are the dominant species present. The few native species also occurring include California-aster (*Corethrogyne filaginifolia*), deerweed (*Acmispon glaber*), and miniature lupine (*Lupinus bicolor*). Seacliff buckwheat is also present within this vegetation type.

3.3.3.3 Anthropogenic

In addition to areas dominated by plant cover, there are areas covered by pavement, unpaved roads and structures within the SLC-4W. Plant cover in these areas is very sparse to absent.

3.3.3.4 Special Status Plant Species and Sensitive Plant Communities

There were no special-status plant species documented during surveys. However, one hundred and eighteen (118) seacliff buckwheat plants were documented during surveys conducted in March 2014 within SLC-4W in non-native grassland habitat (Table 3-4; Figure 3-3; Tetra Tech, Inc. 2014). Seacliff buckwheat is the host plant for the federally endangered ESBB and the presence of seacliff buckwheat within and adjacent to the project site indicates the potential for ESBB to occur within the project site. On VAFB, seacliff buckwheat is considered potential ESBB habitat and receives degrees of protection, depending on proximity to ESBB localities. The SLC-4W project site is approximately 1.5 mi. (2.4 km) from the nearest known ESBB locality. This locality was recorded near the intersection of Coast and Bear Creek Roads and represents an isolated individual observed in 2008. Subsequent surveys in the area conducted in 2008, 2009, 2011, 2012, 2013, and 2014 failed to document additional ESBB (ManTech SRS Technologies, Inc. 2010, 2014a). The closest ESBB population to the proposed construction area is on Honda Ridge

approximately 3.3 mi. south-southeast of the project site (ManTech SRS Technologies, Inc. 2014a).

Table 3-4. Federal and State Special Status Plant Species with Potential to Occur in the Vicinity of the Proposed Construction Area and Sensitive Plant Communities Occurring within the Construction Area

Species	Status		Occurrence	Habitat	Bloom Period
	ESA	CDFW			
Seacliff buckwheat	NL	NL	118 plants	El Segundo blue butterfly habitat	June–September

Notes: ESA = Endangered Species Act, CDFW = California Department of Fish and Wildlife, NL = Not listed

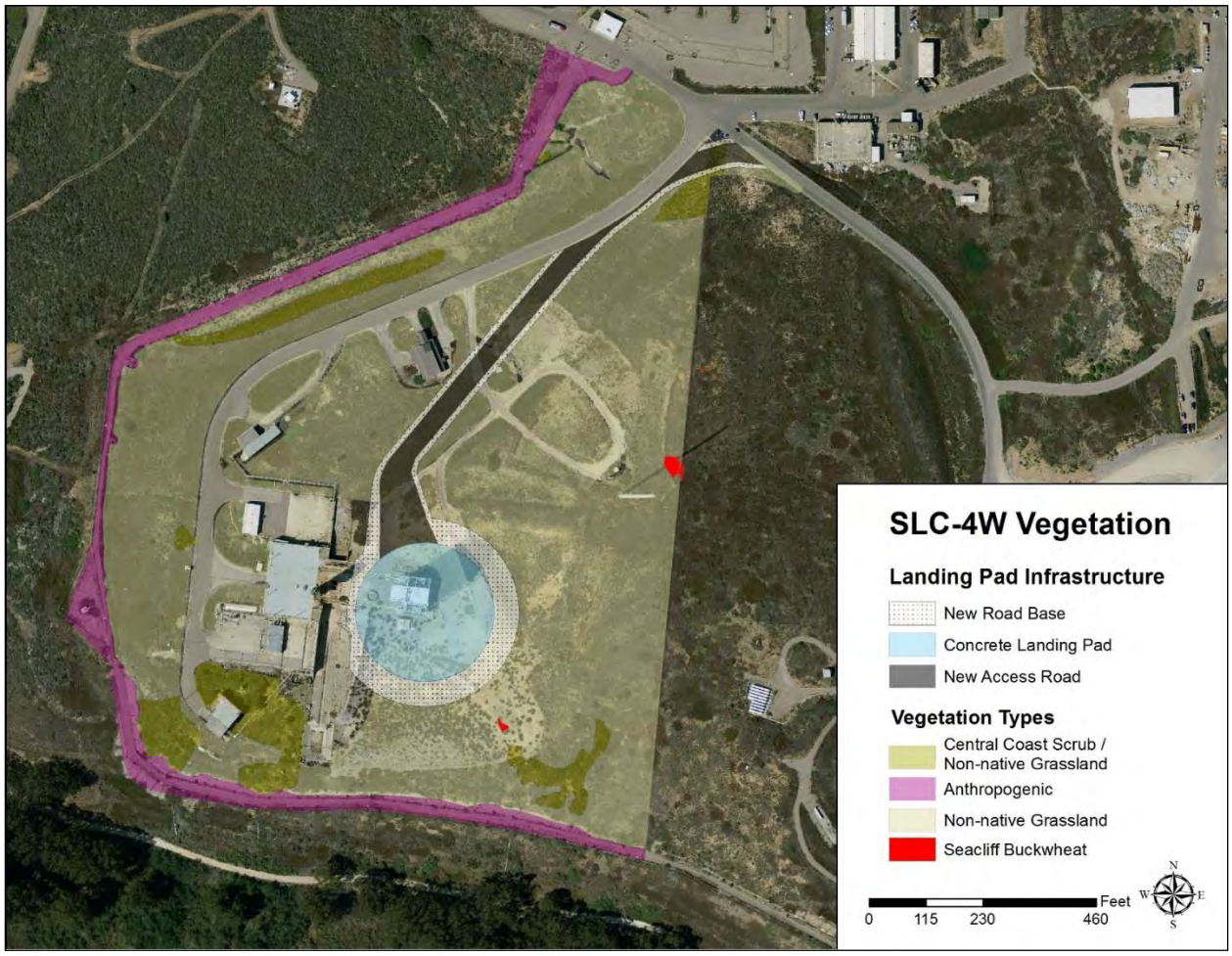


Figure 3-3. Habitat Types and Special Status Species within the Project Area

3.3.4 Wildlife Resources

The ROI for wildlife resources includes the SLC-4W construction area where ground-disturbing activities would take place and terrestrial areas that would potentially be affected by acoustic impacts (Figures 2-4, 2-5, 2-6, 2-9 and 2-10). The diversity of vegetation types and communities present on VAFB provides valuable habitat for many common wildlife species, both within and

adjacent to the project area. Appendix G lists wildlife species documented within the project area during a biological survey conducted in March 2010 (ManTech SRS Technologies, Inc. 2010). This Appendix also includes wildlife species not encountered during surveys but potentially present based on prior records in the vicinity.

Common birds likely to be found within and around the project area include house finch (*Carpodacus mexicanus*), Brewer's blackbird (*Euphagus cyanocephalus*), European starling (*Sturnus vulgaris*), cliff swallow (*Hirundo pyrrhonota*), barn swallow (*Hirundo rustica*), turkey vulture (*Cathartes aura*), red-tailed hawk (*Buteo jamaicensis*), white-throated swift (*Aeronautes saxatalis*), California quail (*Callipepla californica*), black phoebe (*Sayornis nigricans*), and California thrasher (*Toxostoma redivivum*). Nesting cliff swallows, house finches, black phoebes and European starlings have also been documented within SLC-4W (U.S. Air Force 2005a).

The project site may contain upland habitat for amphibians that inhabit Spring Canyon, an ephemeral drainage located immediately south of SLC-4. Due to prolonged drought conditions and low rainfall, Spring Canyon is currently dry; however, if water were present, California chorus frogs (*Pseudacris hypochondriaca*) would likely be the most common amphibian species within the project area. Other wetland amphibian species, such as CRLF, western toad (*Bufo boreas*), Monterey ensatina (*Ensatina eschscholtzii*) and arboreal salamander (*Aneides lugubris*) would also be expected to occur due to the proximity to Spring Canyon. The CRLF is a federally threatened species as well as a California species of concern (see Section 3.3.5, Special Status Wildlife Species in the Terrestrial Portion of the Project Area).

Reptile species expected to occur within the project area include Western fence lizard (*Sceloporus occidentalis*), southern alligator lizard (*Elgaria multicarinata*), side-blotched lizard (*Uta stansburiana*), western skink (*Eumeces skiltonianus*), gopher snake (*Pituophis catenifer*), Pacific rattlesnake (*Crotalus helleri*), and coast horned lizard (*Phrynosoma blainvillii*). A variety of large and medium-sized mammal species are also expected to occur within the project area including coyote (*Canis latrans*), mule deer (*Odocoileus hemionus*), raccoon (*Procyon lotor*), bobcat (*Felis rufus*), brush rabbit (*Sylvilagus bachmani*), desert cottontail (*Sylvilagus audubonii*), and long-tailed weasel (*Mustela frenata*). Small mammals, including various species of mice (*Peromyscus* ssp.), and Botta's pocket gopher (*Thomomys bottae*) are also expected to occur. The project area and surrounding habitat support foraging opportunities for several bat species, but do not provide suitable roosting areas.

3.3.5 Special Status Wildlife Species in the Terrestrial Portion of the Project Area

The ROI for special status wildlife species in the terrestrial portion of the project area includes the SLC-4W construction area where ground-disturbing activities would take place and terrestrial areas that would potentially be affected by acoustic impacts (Figures 2-4, 2-5, 2-6, 2-9 and 2-10) and visual disturbance. Table 3-5 lists federal and state listed wildlife species and other special status species that occur or have the potential to occur within the terrestrial portion of the project area and its vicinity, as well as the launch vehicle's overflight path over land. Potential occurrence was determined based on past documentation of special status species within the vicinity of the Proposed Action Area and on suitability of habitat and occurrence within the region of a particular species.

Several species were excluded from potential occurrence because they either do not occur at the site during the time construction activities would occur, they do not breed within the project area and their special status affords them protection during their breeding period, or they do not occur in a manner that affords them special status protection (i.e., rookeries or nesting colonies). This EA considers species that may be affected by activities under the Proposed Action and Alternatives. Species unlikely to be affected by SLC-4W modifications, landscape maintenance, launch noise, and not present within the overpressure or overflight zones, were not given further consideration. This includes federally listed plant species such as the federally endangered Lompoc yerba santa (*Eriodictyon capitatum*), Gaviota tarplant (*Deinandra increscens* ssp*. villosa*), and Gambel's watercress (*Nasturtium gambellii*).

Special status fish species such as the federally endangered tidewater goby (*Eucyclogobius newberryi*) and federal endangered unarmored threespine stickleback (*Gasterosteus aculeatus williamsoni*), were also not considered due to their absence from the overflight zone, distance from SLC-4W, and the ability of water to attenuate sound. An introduced population of unarmored threespine stickleback occurred at one time within Honda Creek; however, surveys conducted by ManTech SRS Technologies, Inc. in 2008 indicated that this population is no longer extant (ManTech SRS Technologies, Inc. 2009a). The nearest tidewater goby potential habitat is in Cañada Honda Creek, approximately 2.6 mi. (4.2 km) southwest of the project site (ManTech SRS Technologies, Inc. 2009a).

Potential habitat for least Bell's vireo (*Vireo bellii pusillus*, federal endangered species/state endangered species) and southwestern willow flycatcher (*Empidonax traillii extimus*, federal endangered species/state endangered species) exists on VAFB and adjacent areas. However, these species have not been documented within the area potentially impacted by a significant sonic boom and landing noise generated by the First Stage boost-back and landing at SLC-4W in the last 10 years (Seavy et al. 2012). As shown in Figure 2-9, under the contingency landing action, a low-pressure sonic boom (0.2 psf) would extend up to 60 mi. (97 km) onto the mainland, which includes areas where these species may be found. However, at these large distances from the source of the sonic boom, the received frequencies would be low (less than 200 Hz) and therefore outside of the hearing sensitivity of these species (200 Hz to 8 kilohertz [kHz]; Okanoya and Dooling 1987), and thus would not be perceived. Therefore, these species were not carried forward to analyses of impacts.

Golden eagles (*Aquila chrysaetos*, Federal Bird Species of Conservation Concern, California Fully Protected Species) and bald eagles (*Haliaeetus leucocephalus* [Federal Bird Species of Conservation Concern, California Endangered Species, California Fully Protected Species]) are occasionally seen throughout VAFB and may forage in open scrub, grassland, and estuarine habitats. However, these are rarely sighted and are not anticipated to be affected by project activities.

The likelihood of special status seabirds occurring within the area potentially impacted during a contingency offshore landing event is very low; thus, it is highly unlikely that any of individual sea birds would be adversely affected by the Contingency Action under Alternative 1 and these species are not carried forward for analyses.

The following are considered special-status biological resources:

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

Federally listed, proposed listed, or candidate plant and wildlife species that are known to occur in the project area are described below. In addition, species covered under the MMPA that occur in the project area are listed below.

Table 3-5. Special Status Species Occurring or Potentially Occurring within the Terrestrial Portion of the Project Area

Species	Conservation Status		Occurrence within Proposed Action Area		Habitat	Notes
	Federal	CDFW	SLC-4	Overpressure		
Invertebrates						
El Segundo Blue Butterfly *Euphilotes battoides allyni*	FE	-	Potential	Documented	Occurrence is tied to host plant; seacliff buckwheat	Adult flight period June - September
Amphibians						
California Red-legged Frog *Rana draytonii*	FT	CSC	-	Documented	Chiefly associated with perennial ponds, streams	Common, but localized resident in wetlands
Reptiles						
Western Pond Turtle (*Antinemys pallida*)		CSC		Documented	Chiefly associated with perennial ponds, streams	Documented in Honda Creek
Blainville's Horned Lizard *Phrynosoma blainvillii*	-	CSC	Potential	Documented	Scrub, chaparral, and grassland with open shrub canopy and loose sandy or loamy soils	Documented in scrub and chaparral habitats on VAFB
Silvery Legless Lizard *Anniella pulchra*	-	CSC	Potential	Documented	Sparsely vegetated coastal scrub and chaparral with loose sandy or loamy soils	Documented in coastal dunes west of SLC-4
Two-striped Garter Snake *Thamnophis hammondii*	-	CSC	Potential	Documented	Generally found around pools, creeks, cattle tanks, and other water sources, often in rocky areas, in oak woodland, chaparral, and brushland.	Documented observations within three miles of SLC-4
Birds						
California Brown Pelican *Pelecanus occidentalis californicus*	FD	SD, FP	-	Potential	Coastal marine, estuaries	
Ferruginous Hawk *Buteo regalis*	BCC	-	-	Rare	Open grassland, prairie	Wintering birds hunt in fallow fields within the Proposed Action Area
Northern harrier *Circus cyaneus*	-	CSC	Potential	Common	Prairie grasslands, marshes, wetlands	Nesting records near the Proposed Action Area
White-tailed Kite *Elanus leucurus*	-	CSC	Potential	Rare - Common	Open grassland, prairie	Nesting records near SLC-4; numbers vary annually
Golden Eagle *Aquila chrysaetos*	BGEPA, BCC	FP	-	Potential	Grasslands, open woodland	
Bald Eagle *Haliaeetus leucocephalus*	BGEPA, FD	SE	-	Potential	Large lakes, wetlands	Rare winter migrant
American Peregrine Falcon *Falco peregrinus anatum*	FD, BCC	SD, FP	-	Potential	Open with proximity to water	
Western Snowy Plover *Charadrius nivosus*	FT, BCC	CSC	-	Common	Beaches, barren ground	
Black Oystercatcher *Haematopus bachmani*	BCC	-	-	Common	Intertidal	
Long-billed Curlew *Numenius americanus*	BCC	-	-	Common	Intertidal	

California Least Tern *Sternula antillarum browni*	FE	SE	-	Potential	Coastal marine, estuaries	
Burrowing Owl *Athene cunicularia hypugea*	BCC	CSC	-	Common	Grasslands	
Allen's Hummingbird *Selasphorus sasin*	BCC	-	Common	Common	Coastal sage scrub, riparian shrubs	Resident riparian breeder Santa Ynez River
Nuttall's Woodpecker *Picoides nuttallii*	BCC	-	-	Common	Deciduous riparian and adjacent oak woodland	Resident riparian breeder Santa Ynez River
Olive-sided Flycatcher *Contopus cooperi*	-	CSC	-	Rare	Coniferous woods	Summer resident, potential breeder in non-native woodland near Proposed Action Area
Loggerhead Shrike *Lanius ludovicianus*	BCC	-	-	Common	Open grasslands	Resident central coast scrub breeder near the Proposed Action Area
Purple Martin *Progne subis*	-	CSC	-	Very Rare	Open areas, riparian	Fall/Spring transient at the Santa Ynez River mouth
Oak Titmouse *Baeolophus inornatus*	BCC	-	Potential	Common	Dry oak, oak-pine woodlands	Resident riparian breeder Santa Ynez River
Yellow Warbler *Dendroica petechia brewsteri*	BCC	CSC	-	Common	Riparian	Summer resident riparian breeder Santa Ynez River
Yellow-breasted Chat *Icteria virens*	-	CSC	-	Common	Riparian	Summer resident riparian breeder Santa Ynez River
Black-Chinned Sparrow *Spizella atrogularis*	BCC	-	-	Potential	Chaparral, sage, scrub	
Belding's Savannah Sparrow *Posserculucs sandwhichensis beldingi*	-	SE	-	Common	Coastal salt marsh	Localized resident breeder within wetlands on VAFB
Tricolored Blackbird *Agelaius tricolor*	BCC	CSC	-	Rare	Marsh, riparian, agricultural fields	Resident with historic breeding records on VAFB
Lawrence's Goldfinch *Spinus lawrencei*	BCC	-	-	Common	Dry, open woodlands	Summer resident riparian breeder Santa Ynez River
Mammals						
Pallid Bat *Antrozous pallidus*	-	CSC	Potential	Common	Rocky outcroppings, sparsely vegetated grasslands	Resident forager on VAFB
Townsend's Big-eared Bat *Corynorhinus townsendii*	-	SC	Potential	Potential	Pine forests, scrub	
Western Red Bat *Lasiurus blossevillii*	-	CSC	Potential	Common	Forages in forests, woodlands from sea-level up	Resident breeder on VAFB at 13th Street Bridge
Southern Sea Otter *Enhydras lutris nereis*	FE	-		Common	Common in coastal waters with numbers concentrated around kelp beds	May be hauled out within the Project Area
American Badger *Taxidea taxus*	-	CSC	Potential	Potential	Open plains, prairies, dry grasslands	
Pacific Harbor Seal[1] (*Phoca vitulina*)	-	-		Common	Common in coastal waters	Rookery use of VAFB and may be hauled out within the Project Area
California Sea Lion[1] (*Zalophus californianus*)	-	-		Common	Common in coastal waters	Sporadically hauled out within the Project Area

Northern Elephant Seal[1] (*Mirounga angustirostris*)	-	-	Common	Common in coastal waters	Sporadically hauled out within the Project Area
Stellar Sea Lion[1] (*Eumetopias jubatus*)	-	-	Uncommon	Present in small numbers	Sporadically hauled out within the Project Area

[1] These species are discussed further under Section 3.3.6.3 (Marine Mammals).

Notes: FE = Federal Endangered Species, FT = Federal Threatened Species, FC = Federal Candidate Species, BCC = Federal Bird Species of Conservation Concern, BGEPA = Bald and Golden Eagle Protection Act, SE = State Endangered Species, CSC = California Species of Special Concern, SC = State Candidate Species, FP = California Fully Protected Species. Abundant = 15+ individuals per day of survey; Common = Over 15 per year of survey; Rare = 1–15 per year of survey; Very Rare = Less than 1 individual per year of survey; Absent = No records of occurrence.

3.3.5.1 El Segundo Blue Butterfly (*Euphilotes battoides allyni* [Federal Endangered Species])

ESBB were listed as federally endangered on 1 June 1976 (40 Federal Register [FR] 48139 - 48140). Critical habitat was proposed for ESBB in 1977, but has yet to be designated. As a result, the project area is not within critical habitat and the Proposed Action would not affect critical habitat for this species.

The ESBB is a member of the Family Lycaenidae. ESBB adults range in size from 1.7 to 2.1 centimeters (Opler 1999) and are typically active on VAFB from June to mid-August although larvae may be present into September. The dorsal wing color is blue in males and gray-brown in females. The ventral wing surface of both sexes is boldly spotted, with checkered margins and a bold orange aurora on the lower wings.

ESBB are closely associated with their host plant, seacliff buckwheat. Adult ESBB nectar and lay their eggs on buckwheat flowerheads. ESBB larvae feed within the flowerheads until maturation. Upon maturation, larvae burrow into the soil and pupate below the host plant within the root and debris zone (Mattoni 1992). Pupae remain in diapause until at least the following June. The number that close in a given year is dependent on environmental conditions with the majority of the population remaining in diapause on any given year (Pratt and Ballmer 1993).

Although seacliff buckwheat is found on much of VAFB, as of 2014, known ESBB populations on south VAFB are limited to ridgeline habitat along Arguello and Honda Ridge roads and the ridge extending from Tranquillon Peak to Oak Mountain. ESBB occurrence on coastal south VAFB is limited to the observation of a single individual in 2008 at the intersection of Bear Creek and Coast Roads. Five years of follow-up surveys at this location have not documented additional ESBB at this site; the lack of additional observations indicates that this was likely a transitory individual.

Initially, ESBB were thought to be restricted to remnant habitat patches from Playa del Rey to the Palos Verdes Peninsula in Los Angeles County, California (Arnold 1978, 1981). *Euphilotes* were not discovered on VAFB until 2004 (ManTech SRS Technologies, Inc. et al. 2008). Identification of *Euphilotes* species is complex, but based on the morphological and life history traits shared by the VAFB and Los Angeles populations and through consultation with other experts on the *Euphilotes* genus, the USFWS decided in 2006 that the VAFB *Euphilotes* would be treated as the ESBB barring evidence to the contrary.

As discussed in Section 3.3.3.4 (Special Status Plant Species and Sensitive Plant Communities), 118 seacliff buckwheat plants were documented during surveys conducted in March 2014 within SLC-4W (Figure 3-3; Tetra Tech, Inc. 2014). The presence of seacliff buckwheat within and adjacent to the project site indicates the potential for ESBB to occur within the project site. The SLC-4W project site is approximately 1.5 mi. (2.4 km) from the nearest known ESBB locality. This locality was recorded near the intersection of Coast and Bear Creek Roads and represents an isolated individual observed in 2008. Subsequent surveys in the area conducted in 2008, 2009, 2011, 2012, 2013, and 2014 failed to document additional ESBB (ManTech SRS Technologies, Inc. 2010, 2014a). The closest ESBB population to the proposed construction area is on Honda Ridge

approximately 3.3 mi. (5.3 km) south-southeast of the project site (ManTech SRS Technologies, Inc. 2014a).

3.3.5.2 California Red-legged Frog (*Rana draytonii* [Federal Threatened Species/ California Species of Special Concern])

CRLF were listed as federally threatened by the USFWS on 23 May 1996 (61 FR 25813-25833). In 2002, the USFWS issued a Recovery Plan to stabilize and restore CRLF populations (U.S. Fish and Wildlife Service 2002). Critical habitat was designated on 17 March 2010 (50 FR 12816-12959); however, it does not include VAFB, since it was excluded under section 4(b)(2) of the ESA, for reasons including impacts on national security. Critical habitat does not occur within the ROI. As a result, the Proposed Action would not affect critical habitat for this species.

The CRLF is a member of the family Ranidae and is California's largest native frog. To breed, CRLF require water bodies with sufficient hydroperiods and compatible salinity levels to accommodate larval and egg development. Breeding typically takes place from November through April with most egg deposition occurring in March. Eggs require 6–14 days, depending on water temperature, to develop into tadpoles (Jennings 1988). Tadpoles typically require 11–20 weeks to develop into terrestrial frogs (U.S. Fish and Wildlife Service 2002), although some individuals may overwinter in the tadpole stage (Fellers et al. 2001).

Adult CRLF have been documented traveling distances of over 1 mi. (1.6 km) during the wet season and spend considerable time in terrestrial riparian vegetation (U.S. Fish and Wildlife Service 2002). It is thought that riparian vegetation provides good foraging habitat, as well as good dispersal corridors, due to canopy cover and presence of moisture (U.S. Fish and Wildlife Service 2002).

Regular CRLF surveys have occurred across VAFB since the early 1990s (Christopher 1996, 2004; ManTech SRS Technologies, Inc. 2009b) and have shown that CRLF can potentially occur in virtually all known wetlands and bodies of water on VAFB. The Santa Ynez River and Bear Creek, to the north of SLC-4, have CRLF populations and suitable breeding habitat (Christopher 1996, 2004; ManTech SRS Technologies 2009b). Spring Canyon is an ephemeral drainage located approximately 200 ft. south of SLC-4 that has potentially suitable habitat for CRLF in high rain years (ManTech SRS Technologies, Inc. 2013). South of SLC-4, suitable CRLF populations and breeding habitat are found in Cañada Honda Creek and Jalama Creek, along with scattered CRLF localities in minor wetlands and drainages across south VAFB (Christopher 1996, 2004; ManTech SRS Technologies, Inc. 2009a). CRLF populations at Cañada Honda Creek and potentially at Spring Canyon would be within the overflight zone.

During the boost-back and landing of the Falcon 9 Full Thrust First Stage, a sonic boom of 1–2 psf is expected to impact CRLF populations from Purisima Point south to Jalama Creek, including the Santa Ynez River and all of south VAFB (Figure 3-4). During landing, engine noise of approximately 70 dB is expected to impact CRLF populations from San Antonio Creek to Jalama Creek (Figure 3-5). However, only CRLF in Bear Creek, Cañada Honda Creek, the vicinity of SLC-6, and, potentially, Spring Canyon, would be expected to experience landing noise over 100 dB (Figure 3-5).

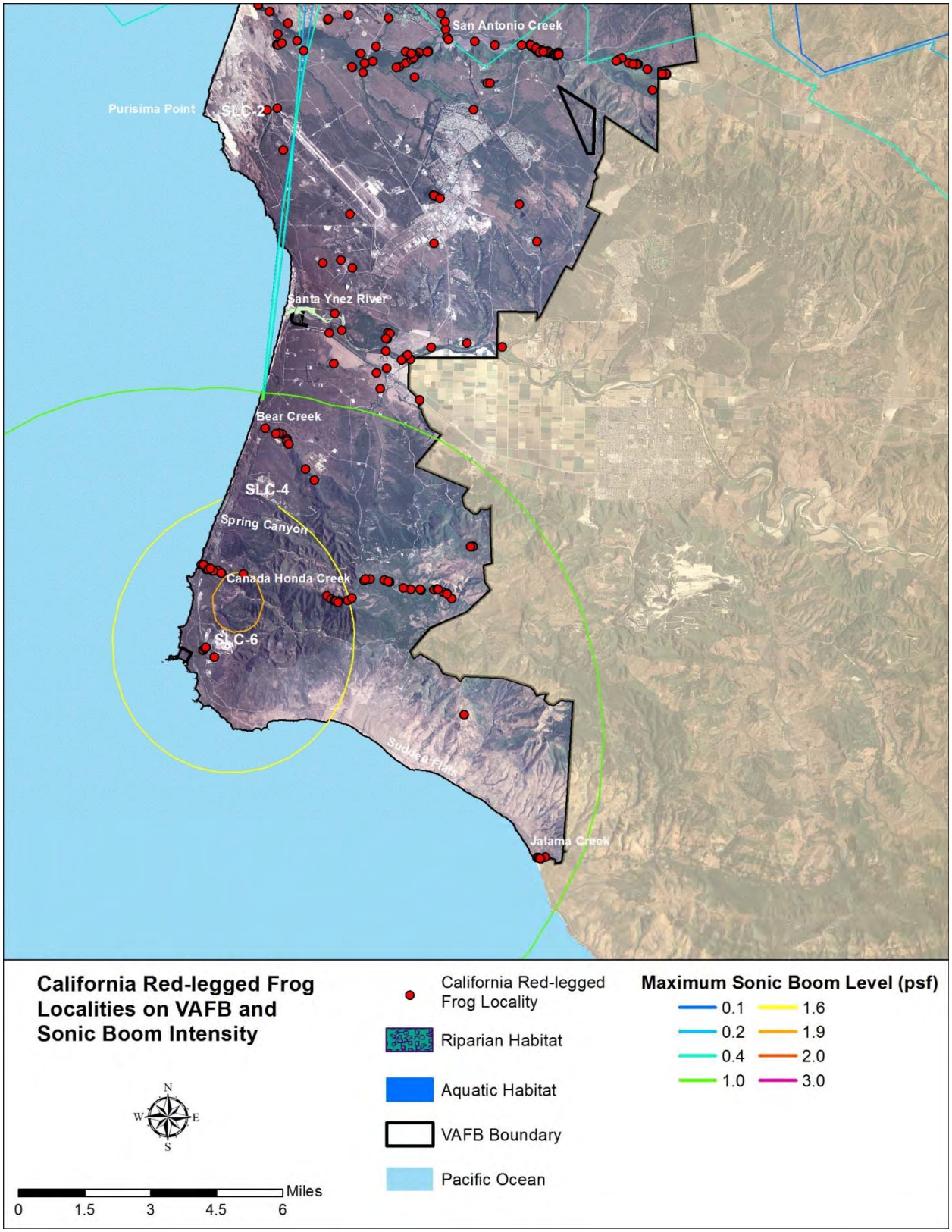


Figure 3-4. CRLF Localities on VAFB and Sonic Boom Intensity

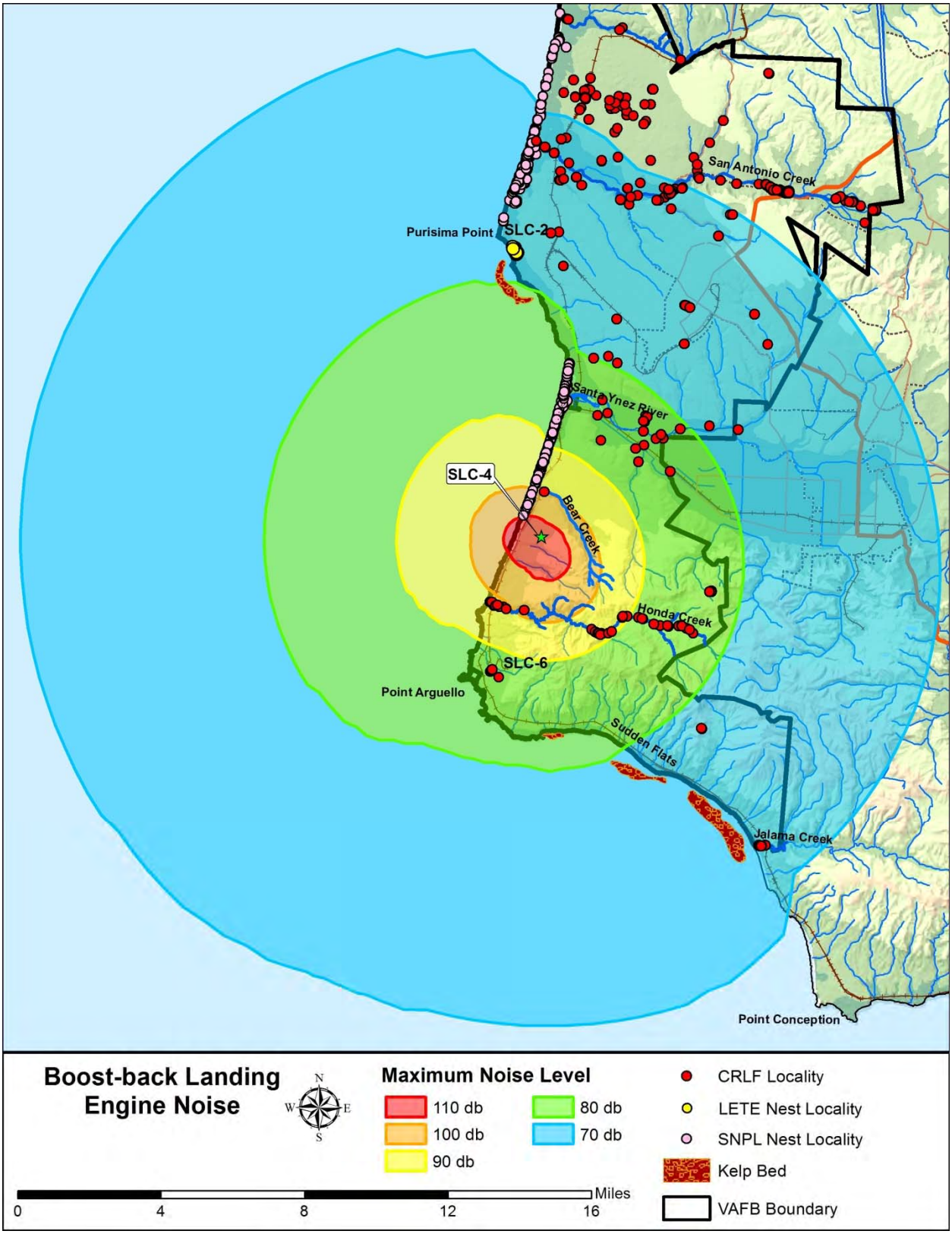


Figure 3-5. Boost-Back Engine Landing Noise Contours Generated by a Sample Trajectory

3.3.5.3 California Least Tern (*Sternula antillarum browni* [Federal Endangered Species/State Endangered Species])

The USFWS listed the LETE as federally endangered on 13 October 1970 (35 FR 16047-16048). Critical habitat for this species has not been designated. As a result, the Proposed Action would not affect critical habitat for this species.

The LETE is the smallest of the North American terns and is found along the Pacific Coast of California, from San Francisco southward to Baja California. It has a distinctive black cap with stripes running across the eyes to the beak. The upperparts are gray and the underparts are white.

The California populations are localized and increasingly fragmented, due to coastal development resulting in habitat loss. LETE are migratory and winter along the Pacific coast of southern Mexico and the Gulf of California. They usually arrive at breeding grounds by the last week of April and return to wintering grounds in August. This species nests in colonies on relatively open beaches kept free of vegetation by natural scouring from tidal or wind action.

Historically, LETE nested in colonies in several locations along the coastal strand of the north VAFB coastline. Since 1998, with the exception of two nests established south of San Antonio Creek in 2002, LETE have nested only at the primary colony site, in relatively undisturbed bluff top open dune habitat at Purisima Point. On VAFB, a LETE breeding colony is found at Purisima Point and LETE forage in the lagoons formed at the mouths of the Santa Ynez River and San Antonio Creek (Figure 3-5), and at other near-shore locations at VAFB. VAFB supports a very small percentage of California's breeding population of LETE. However, as one of only three known breeding colonies between Monterey and Point Conception, the population on VAFB remains significant.

LETE foraging and breeding areas are not within the overflight zone of the Proposed Action. The nearest LETE nesting colony at Purisima Point is located approximately 8 mi. (12.9 km) north (Figure 3-5). The breeding colony is within an area expected to receive landing engine noise within 70–80 dB (Figure 3-5), and a sonic boom up to 0.2 psf (Figure 3-6). Adult LETE forage in the Santa Ynez River lagoon and estuary. After young have fledged in late summer, LETE will also disperse to this location to forage in the lagoon and roost on adjacent sandbars before migrating south for the winter (Robinette and Howar 2010). The Santa Ynez River lagoon is approximately 3.7 mi. (6 km) north of SLC-4W, expected to receive landing engine noise within 80–90 dB (Figure 3-5), and within the area expected to receive a sonic boom up to 1 psf (Figure 3-6).

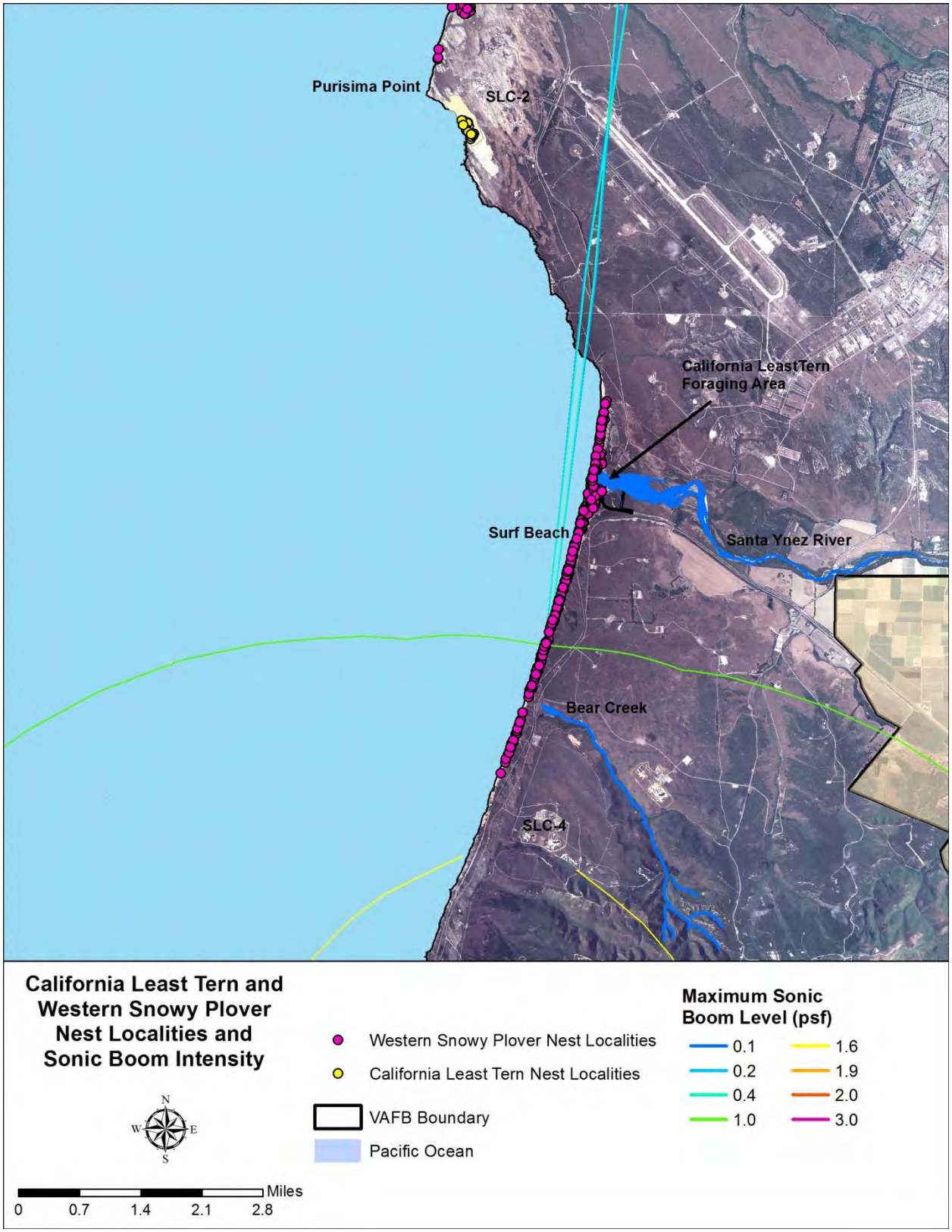


Figure 3-6. Current LETE and SNPL Nesting Localities and Sonic Boom Intensity

3.3.5.4 Western Snowy Plover (*Charadrius nivosus* [Federal Threatened Species/California Species of Special Concern])

The USFWS listed the Pacific coast population of the SNPL as federally threatened in March of 1993 (58 FR 12864-12874). The USFWS designated critical habitat for this species in 1999 and revised this designation on 29 September 2005 (70 FR 56969–57119). VAFB was exempted from critical habitat designation under section 4(a)(3) of the ESA. Critical habitat for this species overlaps the area potentially impacted by a sonic boom on Santa Rosa Island and parts of Ventura and Santa Barbara Counties.

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

VAFB provides important breeding and wintering habitat for SNPL. SNPL habitat on VAFB includes all sandy beaches and adjacent coastal dunes from the rocky headlands at the north end of Minuteman Beach to the pocket beaches and dune areas adjacent to Purisima Point on north VAFB (approximately 7.7 mi. [12.4 km]). Also included are all sandy beaches and adjacent coastal dunes from the rocky headlands at the north end of Wall Beach south to the rock cliffs at the south end of Surf Beach on South VAFB (approximately 4.8 mi. [7.7 km]). VAFB has consistently supported one of the largest populations of breeding SNPL along the west coast of the United States (Page and Persons 1995). In 2014, VAFB supported an estimated 11 percent of California's breeding population (U.S. Fish and Wildlife Service 2014).

SNPL nest and overwinter along the coast of VAFB. The nearest observation of a SNPL nest was approximately 0.9 mi. northwest of SLC-4. Almost all SNPL nesting habitat on VAFB south of Purisima Point is expected to be impacted by a sonic boom of approximately of 1.0–1.6 psf (Figure 3-6) and would experience landing engine noise between 70 and 100 dB (Figure 3-4).

3.3.6 Special Status Species in the Marine Portion of the Project Area

The ROI for special status wildlife species in the marine portion of the project area includes marine areas that would potentially be affected by impacts of the Proposed Action, primarily acoustic impacts (Figures 2-4, 2-5, 2-6, 2-9, 2-10, 2-11, and 2-14), but also by expended materials in the vicinity of the contingency landing location. Fish, sea turtle, seabird species, and marine mammal species protected under the ESA or MMPA, and managed by NOAA Fisheries have the potential to occur in the vicinity of the contingency landing location. However, as stated above, special status seabird species are highly unlikely to be present in the area affected during a contingency offshore landing event due to their extremely low densities. Therefore, they are not carried forward for analyses. Brief descriptions of the species and their potential for occurring in the project area are provided below. Table 3-6 lists non-mammal species potentially occurring within the marine portion of the project area. Table 3-7 lists protected marine mammal species potentially occurring with the marine portion of the project area. One species, the LETE, was already discussed above in relevance to habitat and occurrence on land. It is again discussed below in relevance to occurrence in the marine portion of the project area as they also occur within the area affected by landing noise and sonic boom.

Table 3-6. Special-Status Non-Mammal Species within the ROI for the Proposed Action

Species	Conservation Status	Occurrence within Proposed Action Area	Habitat	Notes
Fish				
Steelhead trout *Oncorhynchus mykiss*	FE	Common	The California Current and open ocean	Southern California distinct population segment[1]
Scalloped Hammerhead Shark *Sphyrna lewini*	FE	Common	Open ocean at depths of 1,000 meters, and coastal waters	Eastern Pacific distinct population segment[1]
Green sturgeon *Acipenser medirostris*	FT	Common	Coastal marine at depths of 20-70 meters	Southern distinct population segment[1]
Basking shark *Cetorhinus maximus*	SOC	Common	The California Current and open ocean	Eastern North Pacific population
Bocaccio *Sebastes paucispinis*	SOC	Common	The California Current and open ocean	Southern California distinct population segment[1]
Cowcod *Sebastes levis*	SOC	Common	The California Current and open ocean	Central Oregon to central Baja California and Guadalupe Island, Mexico evolutionarily significant unit[2]
Sea Turtles				
Green sea turtle *Chelonia mydas*	FT/FE[3]	Potential	Tropical and subtropical coastal and open ocean waters; as well as rocky ridges, channels, and floating kelp	
Hawksbill sea turtle *Eretmochelys imbricata*	FE	Very Rare	Tropical coastal and open ocean waters	No hawksbill sightings have been confirmed along the U.S. west coast in recent history[4]
Loggerhead sea turtle *Caretta*	FE[5]	Rare	Temperate to tropical regions with coastal estuaries to the open ocean	
Olive ridley sea turtle *Lepidochelys olivacea*	FT/FE[6]	Potential	Primarily open ocean in tropical and subtropical regions	
Leatherback sea turtle *Dermochelys coriacea*	FE	Potential	Tropical to subpolar oceans; open ocean and rarely coastal waters	
Seabirds				
California Brown Pelican *Pelecanus occidentalis californicus*	FD	Potential	Coastal marine, estuaries	
California Least Tern *Sternula antillarum browni*	FE	Potential	Coastal marine, estuaries	CLTE have not been found more than two miles off the coast

[1] A species with more than one distinct population segment can have more than one ESA listing status, as individual distinct population segments can be either not listed under the ESA or can be listed as endangered, threatened, or a candidate species.

[2] Evolutionarily significant unit is a population of organisms that is considered distinct for purposes of conservation.

[3] As a species, the green sea turtle is listed as Threatened. However, the Florida and Mexican Pacific Coast nesting populations are listed as Endangered. Green sea turtles found in the Study Area may include individuals from the Mexican Pacific Coast population.
[4] Eckert 1993; NOAA Fisheries and USFWS 2007b
[5] The only distinct population segment of loggerheads that occurs in the Study Area—the North Pacific Ocean distinct population segment—is listed as Endangered.
[6] NOAA Fisheries and USFWS only consider the breeding populations of Mexico's Pacific coast as Endangered. Other populations are listed as Threatened (NOAA Fisheries and USFWS 1998a).
Notes: SOC = Species of Concern, FD = Federally de-listed, FE = Federal Endangered Species, FT = Federal Threatened Species, FC = Federal Candidate Species, BCC = Federal Bird Species of Conservation Concern, SE = State Endangered Species, CSC = California Species of Special Concern, SC = State Candidate Species, FP = California Fully Protected Species, D = MMPA Depleted Strategic Stock, CLTE = California Least Tern

Table 3-7. Status of Protected Marine Mammal Species Potentially Offshore and within the Contingency Landing Area of Effect

Species	Conservation Status		Occurrence within Proposed Project Area	Habitat	Notes
	ESA	MMPA	Offshore drone ship/landing site		
Carnivores					
Southern Sea Otter *Enhydra lutris nereis*	FT	-	Unlikely	Nearshore waters, kelp beds,	The area between SLC-4 and Point Arguello is not regularly occupied and no otters have been detected at this location during the last three annual spring census counts from 2011 to 2014[1]
Pinnipeds					
Pacific Harbor Seal *Phoca vitulina richardsi*	NL	-	Common	Rocks and beach haul-outs, nearshore	
California Sea Lion *Zalophus californianus*	NL	-	Common	Rocks and beach haul-outs, nearshore	
Northern Elephant Seal *Mirounga angustirostris*	NL	-	Common	Rocks and beach haul-outs, nearshore	
Steller Sea Lion *Eumetopias jubatus*	FD	-	Unlikely	Rocks and beach haul-outs, nearshore	
Northern Fur Seal *Callorhinus ursinus*	NL	D/-[2]	Common	Rocks and beach haul-outs, nearshore	
Guadalupe Fur Seal *Arctocephalus townsendi*	FT	D	Rare	Open ocean	
Cetaceans					
Humpback whale *Megaptera novaeangliae*	FE	D	Common Seasonal	Open ocean and coastal waters	Summer feeding ground, peak occurrence is December through June[3]
Blue whale *Balaenoptera musculus*	FE	D	Common Seasonal	Open ocean and coastal waters	
Fin whale *Balaenoptera physalus*	FE	D	Common year-round	Offshore waters, open ocean	
Sei whale *Balaenoptera borealis*	FE	D	Rare	Offshore waters, open ocean	Primarily are encountered there during July to September and leave California waters by mid-October

Species	Conservation Status		Occurrence within Proposed Project Area	Habitat	Notes
	ESA	MMPA	Offshore drone ship/landing site		
Bryde's whale *Balaenoptera brydei/edeni*	NL	-	Rare	Open ocean	
Minke whale *Balaenoptera acutorostrata*	NL	-	Common	Nearshore and offshore	Less common in summer; small numbers around northern Channel Islands
Gray whales *Eschrichtius robustus*	FE/NL[4]	**D/-[4]**	Seasonal	Nearshore and offshore	
Sperm whale *Physeter microcephalus*	FE	D	Common year-round	Nearshore and offshore	Widely distributed year-round; More likely in waters > 1,000 m depth, most often > 2,000 m
Pygmy sperm whale *Kogia breviceps*	NL	-	Potential	Nearshore and open ocean	
Dwarf sperm whale *Kogia sima*	NL	-	Potential	Open ocean	
Killer whale *Orcinus orca*	NL	-	Uncommon	Nearshore and open ocean	
Short-finned pilot whales *Globicephala macrorhynchus*	NL	-	Uncommon	Offshore, open ocean	
Long-beaked common dolphins *Delphinus capensis*	NL	-	Common	Nearshore (within 57.5 mi. [92.5 km])	
Short-beaked common dolphins *Delphinus delphis*	NL	-	Common	Nearshore and open ocean	One of the most abundant CA dolphins; higher summer densities
Common bottlenose dolphin *Tursiops truncates*	NL	-	Common	Coastal and offshore	
Striped dolphin *Stenella coeruleoalba*	NL	-	Uncommon	Offshore	Warm water oceanic species
Rough-toothed dolphin *Steno bredanensis*	NL	-	Rare	Offshore and open ocean	
Pacific white-sided dolphin *Lagenorhynchus obliquidens*	NL	-	Common	Open ocean and offshore	year round cool water species; more abundant Nov-Apr
Northern right whale dolphin *Lissodelphis borealis*	NL	-	Common	Open ocean	year round cool water species; more abundant Nov-Apr

Species	Conservation Status		Occurrence within Proposed Project Area	Habitat	Notes
	ESA	MMPA	Offshore drone ship/landing site		
Risso's dolphin *Grampus griseus*	NL	-	Common	Nearshore and offshore	Higher densities Nov-Apr
Dall's Porpoise *Phocoenoides dalli*	NL	-	Common	Inshore/offshore	Higher densities Nov-Apr
Cuvier's beaked whale *Ziphius cavirostris*	NL	-	Potential	Open ocean	Possible year-round occurrence but difficult to detect due to diving behavior
Baird's beaked whale *Berardius bairdii*	NL	-	Potential	Open ocean	Primarily along continental slope from late spring to early fall
Blainville's beaked whale *Mesoplodon densirostris*	NL	-	Potential	Open ocean	Distributed throughout deep waters and continental slope regions; difficult to detect given diving behavior
Ginkgo-toothed beaked whale *Mesoplodon ginkgodens*	NL	-	Potential	Open ocean	Range generally includes California current system North Pacific Gyre
Perrin's beaked whale *Mesoplodon perrini*	NL	-	Potential	Open ocean	Range generally includes California current system North Pacific Gyre
Stejneger's beaked whale *Mesoplodon stejnegeri*	NL	-	Potential	Open ocean	Southern limit in the central Pacific is unknown but is likely to range between 50° N and 60° N, and 30° N[5]
Hubbs' beaked whale *Mesoplodon carlhubbsi*	NL	-	Potential	Open ocean	Speculated that the Hubbs' beaked whales' range includes the northernmost central California coastline[6]
Pygmy beaked whale *Mesoplodon peruvianus*	NL	-	Potential	Open ocean	Normally inhabit continental slope and deep oceanic waters and are only occasionally reported in waters over the continental shelf

[1] U.S. Geological Survey Western Ecological Resource Center 2014

[2] The eastern Pacific stock is listed as depleted under the MMPA, while the San Miguel Island stock is protected under the MMPA but is not considered depleted (Carretta et al. 2015).

[3] Calambokidis et al. 2001

[4] Both populations of gray whale are protected under the MMPA; the western north pacific stock is listed as endangered under the ESA and depleted under the MMPA. Eastern gray whales are frequently observed in Southern California waters.

[5] Loughlin and Perez 1985; MacLeod et al. 2006

[6] Mead 1989 Both populations of gray whale are protected under the MMPA; the Western North Pacific stock is listed as endangered under the ESA and depleted under the MMPA. Eastern gray whales are frequently observed in Southern California waters (Carretta et al. 2000, Forney et al. 1995, Henkel and Harvey 2008, Hobbs et al. 2004).

Notes: CA = California, m = meter(s), mi. = mile(s), km = kilometer(s), SOC = Species of Concern, FD = Federally de-listed, FE = Federal Endangered Species, FT = Federal Threatened Species, FC = Federal Candidate Species, D = MMPA Depleted Strategic Stock, NL = Not listed

3.3.6.1 Fish

3.3.6.1.1 Steelhead Trout (Oncorhynchus mykiss [Federally Endangered DPS])

Steelhead trout are federally protected by the designation of distinct population segments (DPS), which is defined as a population or group of populations that is discrete or separate from other populations of the same species and are equivalent to evolutionarily significant units. Distinct population segments are also the smallest division of a taxonomic species permitted to be protected under the ESA (West Coast Salmon Biological Review Team et al. 2003).

Critical habitat for 10 west coast steelhead DPSs has been designated. Critical habitat in southern California includes the estuarine and freshwater habitat of San Juan Creek, Trabuco Creek, and San Mateo Creek, which is approximately 250 mi. (402 km) south of VAFB, and about 71 mi. (114 km) south of Long Beach, CA.

The Pacific Ocean distribution of steelhead extends from the Kamchatka Peninsula in Asia, east to Alaska and south to southern California, although the species' historical range extended at least to Mexico (Good et al. 2005). North American steelhead often migrate to distant ocean areas. The known ocean range of North American steelhead utilizing tagging information extends in a broad swath across almost the entire North Pacific, south to 40^{o} 58' north (N) and west to 163^{o} 32' east (Quinn and Myers 2004). Spawning occurs exclusively in freshwater habitat, including inshore rivers and streams. After moving downstream and into marine waters, steelhead tend to migrate immediately offshore. Although, in general, steelhead tend to remain closer to shore than other Pacific salmon species, and are expected to occur mainly within the coastal waters of the California Current (Beamish et al. 2005; Quinn and Myers 2004).

3.3.6.1.2 Scalloped Hammerhead Shark (Sphyrna lewini [Federally Endangered DPS])

In 2013, based on the best scientific and commercial information available, including the status review report (Miller et al. 2013), and other information available since completion of the status review report, NOAA Fisheries determined that the species is comprised of six DPSs that qualify as species under the ESA. After reviewing the best available scientific and commercial information on the DPSs, they determined that two DPSs warranted listing as endangered, the Eastern Atlantic and Eastern Pacific DPSs. The Eastern Pacific DPS occurs within Action Area. Critical habitat for this species has not been designated for this species. As a result, the Proposed Action would not affect critical habitat for this species. The scalloped hammerhead shark is circumglobal, occurring in all temperate to tropical waters (Duncan and Holland 2006) from the surface to depths of 275 m (902 ft.). It typically inhabits nearshore waters of bays and estuaries where water temperatures are at least 22 degrees Centigrade (°C) (72°F) (Castro 1983; Compagno 1984). The scalloped hammerhead shark remains close to shore during the day and moves to deeper waters at night to feed (Bester 1999). In the eastern Pacific, the scalloped hammerhead ranges from southern California (including the Gulf of California) to Panama, Ecuador, and northern Peru, and includes waters in the project area.

3.3.6.1.3 North American Green Sturgeon (Acipenser medirostris [Federally Threatened DPS])

Upon completion of a status review, NOAA Fisheries determined that green sturgeon comprise two DPSs that qualify as species: a northern DPS, consisting of populations in coastal systems from the Eel River, California northward, that was determined to not warrant listing; and a southern DPS consisting of coastal and Central Valley populations south of the Eel River, with the only known spawning population in the Sacramento River. In 2006, NOAA Fisheries listed the southern DPS of North American green sturgeon (hereafter referred to as "green sturgeon") as a threatened species under the ESA. Critical habitat for this species has not been designated for this species. As a result, the Proposed Action would not affect critical habitat for this species. Green sturgeon are a long-lived, slow-growing species like all sturgeon. Adult green sturgeon typically migrate into freshwater beginning in late February and spawn from March to July. The principal factor in the decline of the green sturgeon is the reduction of the spawning habitat to a limited section of the Sacramento River

3.3.6.2 Sea Turtles

3.3.6.2.1 Green Sea Turtle (Chelonia mydas [Federally Threatened])

The green sea turtle was listed under the ESA in July 1978 because of excessive commercial harvest, a lack of effective protection, evidence of declining numbers, and habitat degradation and loss (NOAA Fisheries and USFWS 2007a). The green sea turtle breeding populations off Florida and the Pacific coast of Mexico are listed as endangered, and all other populations are listed as threatened. The green sea turtle is found in tropical and subtropical coastal and open ocean waters, between 30° N and 30° S. Critical habitat has not been designated in the Pacific Ocean. As a result, the Proposed Action would not affect critical habitat for this species. There are very few reports of turtles from southern Pacific Ocean populations occurring in the northern Pacific Ocean (Limpus et al. 2009). Green sea turtles are widely distributed in the subtropical coastal waters of southern Baja California, Mexico, and Central America, several hundred km south of the Action Area (Cliffton et al. 1995; NOAA Fisheries Service and USFWS 1998b). Another green sea turtle population resides in Long Beach, California, although less is known about this population (Eguchi et al. 2010). Ocean waters off Southern California and northern Baja California are designated as areas of occurrence because of the presence of rocky ridges and channels and floating kelp habitats suitable for green sea turtle foraging and resting (Stinson 1984); however, these waters are often at temperatures below the thermal preferences of this primarily tropical species. Sufficient data is not currently available to estimate densities of this species off the coast of VAFB (U.S. Department of the Navy 2014a).

3.3.6.2.2 Hawksbill Sea Turtle (Eretmochelys imbricata [Federally Endangered])

The hawksbill turtle is listed as endangered under the ESA (NOAA Fisheries and USFWS 1998c). Critical habitat has not been designated for the hawksbill in the Pacific Ocean. As a result, the Proposed Action would not affect critical habitat for this species. Water temperature in the Southern California region of the Study Area is generally too low for hawksbills, and they are rare. Nesting is rare in the eastern Pacific Ocean region, and does not occur along the U.S. west coast

(NOAA Fisheries and USFWS 1998c; Witzell 1983). Stinson (1984) did not mention the hawksbill turtle in her summary of sea turtle occurrences in eastern north Pacific waters from Baja California to the Gulf of Alaska, and no hawksbill sightings have been confirmed along the U.S. west coast in recent history (Eckert 1993; NOAA Fisheries and USFWS 2007b). If hawksbills were to occur in the Southern California region of the Study Area, it would most likely be during an El Niño event, when waters along the California current are unusually warm (NOAA Fisheries 2008). The U.S. Navy has assumed that this species does not occur in the Eastern Pacific off the coast of Southern California (U.S. Department of the Navy 2014a). As a result, we assume this species is very unlikely to occur within the region of the contingency landing area.

3.3.6.2.3 Loggerhead Sea Turtle (Caretta [Federally Endangered])

In September 2011, NOAA Fisheries listed all three Pacific Ocean distinct population segments of loggerhead sea turtles as endangered (76 FR 588868). There is no critical habitat designated for the North Pacific Ocean DPS. As a result, the Proposed Action would not affect critical habitat for this species. Loggerhead sea turtles are one of the larger species of turtle, named for their large blocky heads that support powerful jaws used to feed on hard-shelled prey. The loggerhead is found in temperate to tropical regions of the Atlantic, Pacific, and Indian Oceans and in the Mediterranean Sea (Conant et al. 2009). The highest densities of loggerheads can be found just north of Hawaii in the North Pacific Transition Zone (Polovina et al. 2000). The North Pacific Transition Zone is defined by convergence zones of high productivity that stretch across the entire northern Pacific Ocean from Japan to California (Polovina et al. 2001). The loggerhead turtle is known to occur at sea in Southern California, but does not nest on Southern California beaches. Loggerhead turtles primarily occupy areas where the sea surface temperature is between 59°F and 77°F (15°C and 25°C). Sufficient data is not currently available to estimate densities of this species off the coast of VAFB (U.S. Department of the Navy 2014a).

3.3.6.2.4 Olive Ridley Sea Turtle (Lepidochelys olivacea [Federally Endangered])

The Mexican Pacific Ocean coast nesting population has been classified as endangered because of extensive overharvesting of olive ridley turtles in Mexico, which caused a severe population decline (NOAA Fisheries and USFWS 1998d). Olive ridleys in the Action Area would likely belong to this population. All other populations are listed under the ESA as threatened (NOAA Fisheries and USFWS 1998d). Critical habitat has not been designated for the olive ridley. As a result, the Proposed Action would not affect critical habitat for this species. Most olive ridley turtles lead a primarily open ocean existence (NOAA Fisheries and USFWS 1998d). Individuals occasionally occur in waters as far north as California and as far south as Peru, spending most of their life in the oceanic zone (NOAA Fisheries and USFWS 2007c). The olive ridley has a large range in tropical and subtropical regions in the Pacific Ocean, and is generally found between 40° N and 40° S. Sufficient data is not currently available to estimate densities of this species off the coast of VAFB (U.S. Department of the Navy 2014a).

3.3.6.2.5 Leatherback Sea Turtle (Dermochelys coriacea [Federally Endangered])

The leatherback turtle is listed as a single population, and is classified as endangered under the ESA. Leatherbacks are known as an open ocean species, but can also be found in coastal waters

within the Action Area. In 2012, NOAA Fisheries designated critical habitat for the leatherback sea turtle in California (from Point Arena to Point Arguello) and from Cape Flattery, Washington, to Winchester Bay, Oregon, out to the 2,000 mi. (3,219 km) depth contour (NOAA Fisheries 2012). This critical habitat designation is within the area of the contingency plan for the Proposed Action and is discussed in Section 3.3.7 (Sensitive Marine Habitats), below. There is one primary constituent element that is essential to the conservation of leatherback sea turtles in marine waters on the U.S. West Coast. It is the occurrence of prey species, primarily scyphomedusae of the order Semaeostomeae (*Chrysaora, Aurelia, Phacellophora,* and *Cyanea*), of sufficient condition, distribution, diversity, abundance, and density necessary for growth and success of leatherback sea turtles (NOAA Fisheries 2012).

The leatherback turtle is the most widely distributed of all sea turtles, found from tropical to subpolar oceans, and nests on tropical and occasionally subtropical beaches (Gilman 2008; Myers and Hays 2006; NOAA Fisheries and USFWS 1992). Found from 71° N to 47° S, it has the most extensive range of any adult turtle (Eckert 1995). Leatherback sea turtles typically are found to forage in the area around the Proposed Action during the spring and early summer when waters are cool, they move further east and north during the late summer (NOAA Fisheries 2012). Leatherback turtles are regularly seen off the western coast of the United States, with the greatest densities found off central California. Off central California, sea surface temperatures are highest during the summer and fall, and oceanographic conditions create favorable habitat for leatherback turtle prey jellyfish (NOAA Fisheries 2012). Numerous NOAA Fisheries survey sightings of leatherbacks have been recorded in the waters of Southern California, with nearly all of those sightings occurring in deeper waters seaward of the Channel Islands. We assumed a conservative estimate for density of 0.036 individuals per km^2, based on densities off shore of San Francisco (U.S. Department of the Navy 2014a).

3.3.6.3 Marine Mammals

In additional to the six pinniped species described in the sections below, 28 cetaceans (whales and dolphins) may be present in the area identified for a contingency drone ship landing, as described in Section 2.3.2 (Falcon 9 Boost-Back and Landing) (Table 3-7). Information on the likelihood of cetaceans occurring in the vicinity of the contingency landing location is provided following the pinniped sections. The estimated at-sea density for the following species is assumed to be zero in the project area, because these species are very unlikely to occur or are not known to occur in the region: pygmy killer whale (*Feresa attenuata*), false killer whale (*Pseudorca crassidens*), Hawaiian monk seal (*Monachus schauinslandi*), Longman's beaked whale (*Indopacetus pacificus*), Fraser's dolphin (*Lagenodelphis hosei*), spinner dolphin (*Stenella longirostris*), pantropical spotted dolphin (*Stenella attenuata*), and melon-headed whale (*Peponocephala electra*).

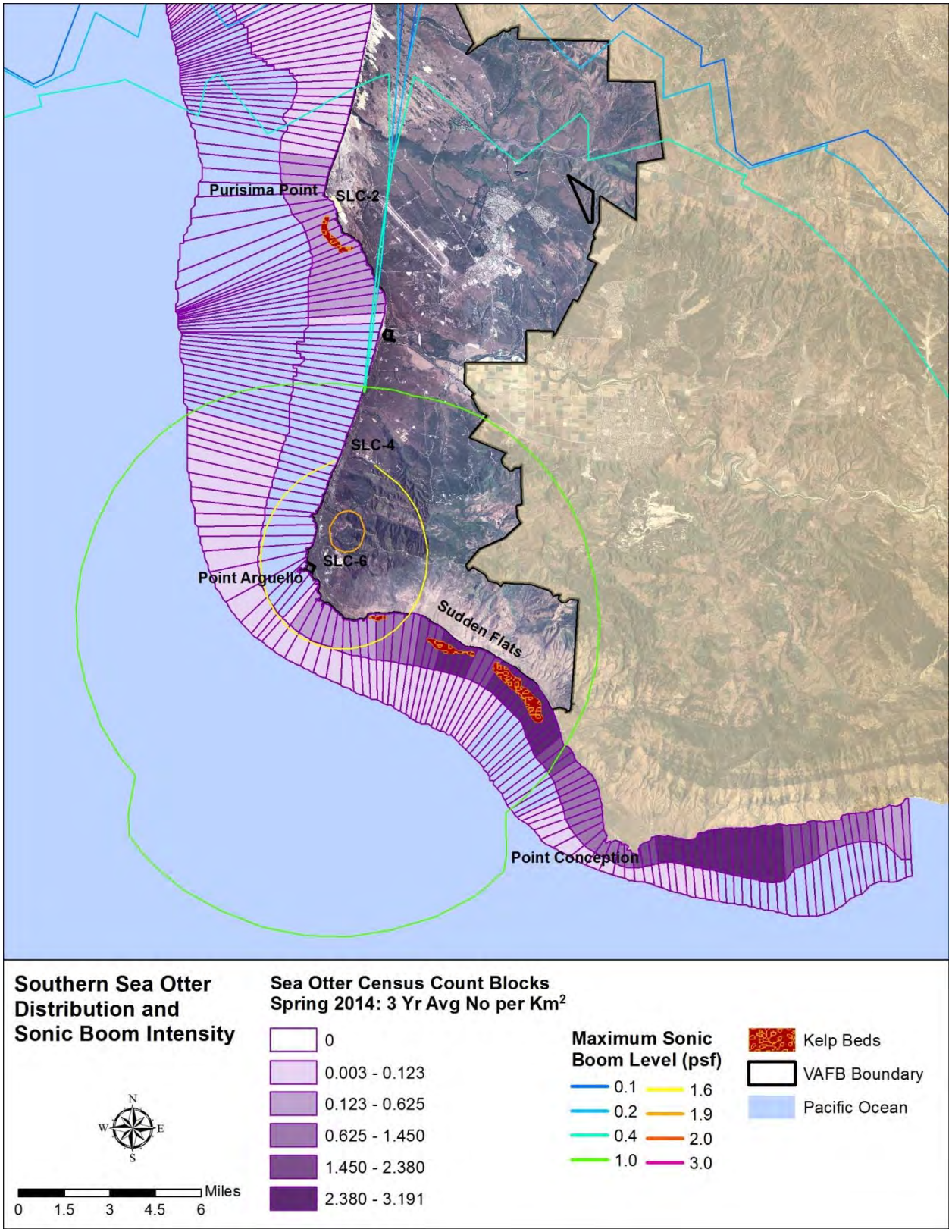
3.3.6.3.1 Southern Sea Otter (Enhydra lutris nereis [Federal Threatened Species])

The USFWS listed the southern sea otter as federally threatened on 14 January 1977 (42 FR 2965). Critical habitat for this species has not been designated. As a result, the Proposed Action would not affect critical habitat for the sea otter. The southern sea otter is the smallest species of marine mammal in North America. It inhabits the nearshore marine environments of

California from San Mateo County to Santa Barbara County. This species breeds and gives birth year-round and pups are dependent for 120–280 days (average 166 days; Riedman and Estes 1990). Sea otters are opportunistic foragers known to eat mostly abalones, sea urchins, crabs, and clams. They play a key ecological role in kelp bed communities by eating sea urchins that eat and destroy kelp beds.

Sea otters inhabit the waters along VAFB. Annual surveys by U.S. Geological Survey (USGS) have documented persistent populations in nearshore waters off Sudden Flats and Purisima Point (U.S. Geological Survey Western Ecological Resource Center 2014). As many as 55 adult otters have been documented in the Sudden Flats area at one time (SRS Technologies, Inc. 2006a), and as many as 18 adult otters have been documented in the Purisima Point area at one time (SRS Technologies, Inc. 2002).

Southern sea otters occur regularly off the coast of VAFB, with animals typically concentrated in the kelp beds offshore of Purisima Point on north VAFB, and offshore of Sudden Flats on south VAFB (Figure 3-7). VAFB sea otters inhabiting the coast between Purisima Point and Sudden Flats could be impacted by a sonic boom of 1.0–1.6 psf (Figure 3.7). Sea otters inhabiting the kelp beds at Purisima Point and the kelp beds between Point Arguello and Jalama Creek would be expected to experience landing engine noise between 70 and 80 dB (Figure 3-5). Transitory otters traversing the coast between SLC-4 and Point Arguello may be impacted by a sonic boom as high as 2 psf (Figure 3-7) and landing engine noise as great as 110 dB. (Figure 3-5); this area is, however, not regularly occupied and no otters have been detected at this location during the last three annual spring census counts from 2011 to 2014 (U.S. Geological Survey Western Ecological Resource Center 2014). Sea otters would not be present at the contingency landing area described under Alternative 1 or offshore landing areas under Alternative 2 and the No Action Alternative.



Source: U.S. Geological Survey 2014

Figure 3-7. Southern Sea Otter Distribution and Sonic Boom Intensity

3.3.6.3.2 Pacific Harbor Seal (Phoca vitulina richardsi [Not Listed])

Pacific harbor seals congregate on multiple rocky haul-out sites along the VAFB coastline. Most haul-out sites are located between the Boat House and South Rocky Point, as shown in Figure 3-8, where most of the pupping on VAFB occurs. These haul-out sites are more than 5 mi. (8.1 km) from SLC-4W and are not within the overflight zone of Alternative 1 or Alternative 2. However, noise levels from the First Stage landing may reach 80 dB at the haul-out sites (Figure 3-8), and sonic boom pressure levels could reach 2.0 psf (Figure 3-9). Pups are generally present in the region from March through July. Within the affected area on VAFB, up to 332 adults and 34 pups have been recorded in monthly counts from 2013 to 2015 (ManTech SRS Technologies, Inc. 2014b, 2015b). During aerial pinniped surveys of haul outs located in the Point Conception area by NOAA Fisheries in May 2002 and May and June of 2004, between 488 to 516 harbor seals were recorded. Harbor seals also haul out, breed, and pup in isolated beaches and coves throughout the coasts of San Miguel, Santa Rosa, and Santa Cruz Islands (Lowry 2002). During aerial surveys conducted by NOAA Fisheries in May 2002 and May and June of 2004, between 521 and 1,004 harbors seals were recorded at San Miguel Island, between 605 and 972 at Santa Rosa Island, and between 599 and 1,102 Santa Cruz Island (Lowry 2015). The at-sea estimated density for harbor seals is 0.02 individuals per km^2 in the contingency landing area of effect (U.S. Department of the Navy 2014a).

3.3.6.3.3 California Sea Lion (Zalophus californianus [Not Listed])

California sea lions haul out sporadically on rocks and beaches along the coastline of VAFB. Therefore, there is the potential that California sea lions could haul-out within the overflight zone of the Alternative 1 or Alternative 2. Noise levels from the First Stage landing may reach 80 dB at the haul-out sites (Figure 3-8), and sonic boom pressure levels could reach 2.0 psf (Figure 3-9). Figure 3-10 depicts marine mammal haul outs on VAFB and expected sonic boom levels for an SLC-4W landing. In 2014, counts of California sea lions at haul outs on VAFB increased substantially, ranging from 47 to 416 during monthly counts (ManTech SRS Technologies, Inc. 2015b). However, California sea lions rarely pup on the VAFB coastline: no pups were observed in 2013 or 2014 (ManTech SRS Technologies, Inc. 2014b, 2015b) and 1 pup was observed in 2015. Pupping occurs in large numbers on San Miguel Island at the rookeries found at Point Bennett on the west end of the island and at Cardwell Point on the east end of the island (Lowry 2002). During aerial surveys of the Northern Channel Islands conducted by NOAA Fisheries in February 2010, 21,192 total California sea lions (14,802 pups) were observed at haul outs on San Miguel Island and 8,237 total (5,712 pups) at Santa Rosa Island (Lowry 2015). During aerial surveys in July 2012, 65,660 total California sea lions (28,289 pups) were recorded at haul outs on San Miguel Island, 1,584 total (3 pups) at Santa Rosa Island, and 1,571 total (zero pups) at Santa Cruz Island (Lowry 2015). The at-sea estimate density for California sea lions is 2.5 individuals per km^2 in the contingency landing area of effect (U.S. Department of the Navy 2014a).

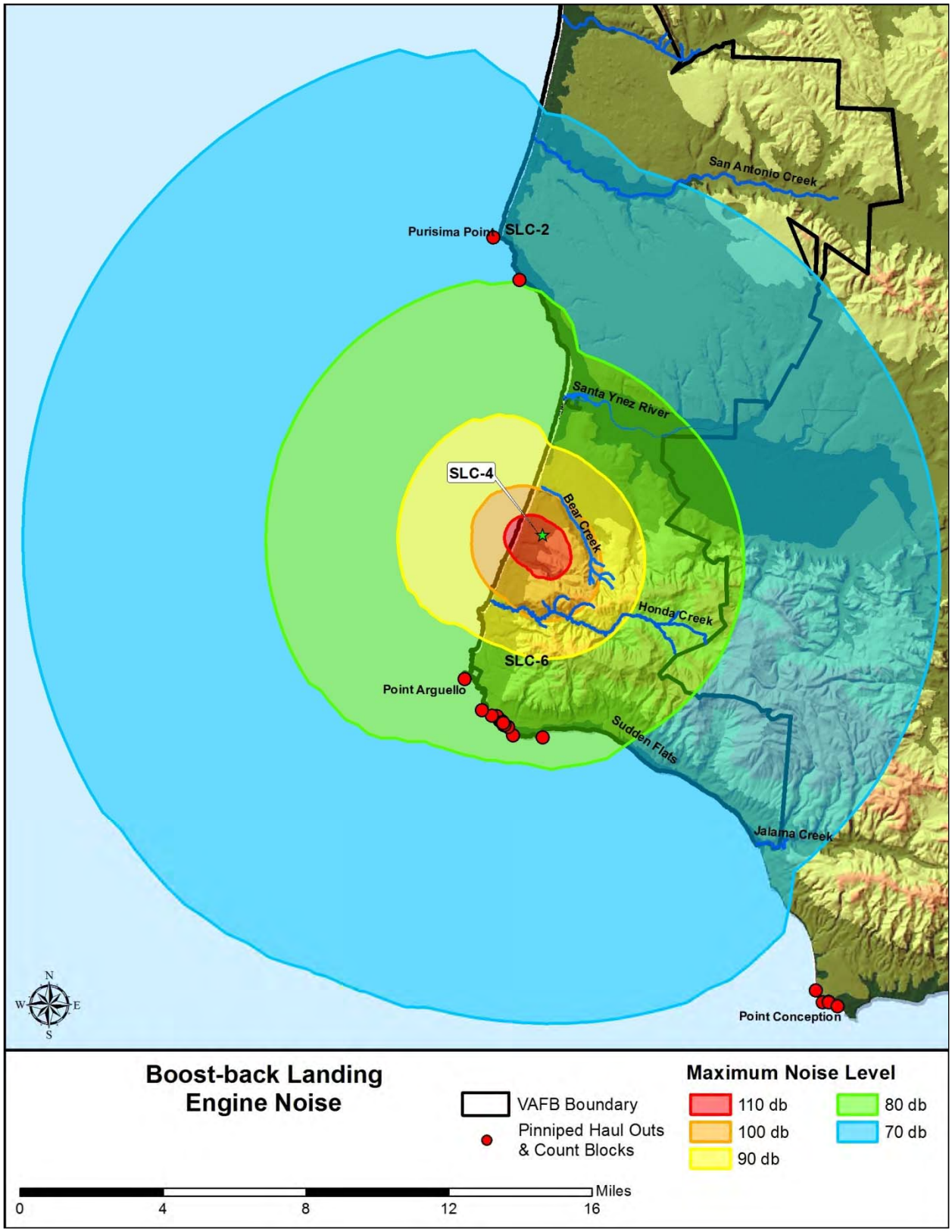


Figure 3-8. Marine Mammal Haul Out Sites on Within the Region of Expected Landing Noise for SLC-4W Landing

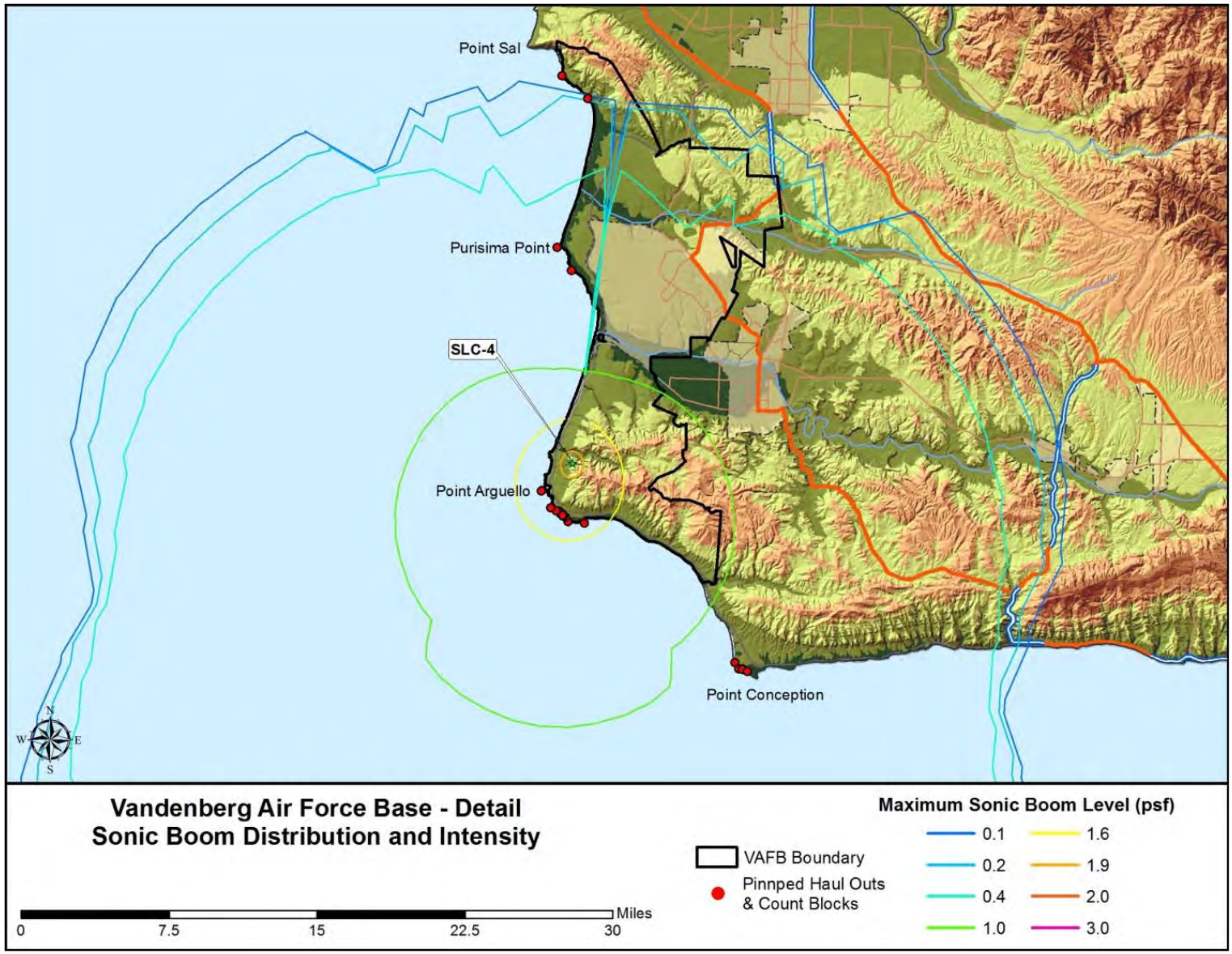


Figure 3-9. Marine Mammal Haul Outs on VAFB and Expected Sonic Boom Levels for SLC-4W Landing

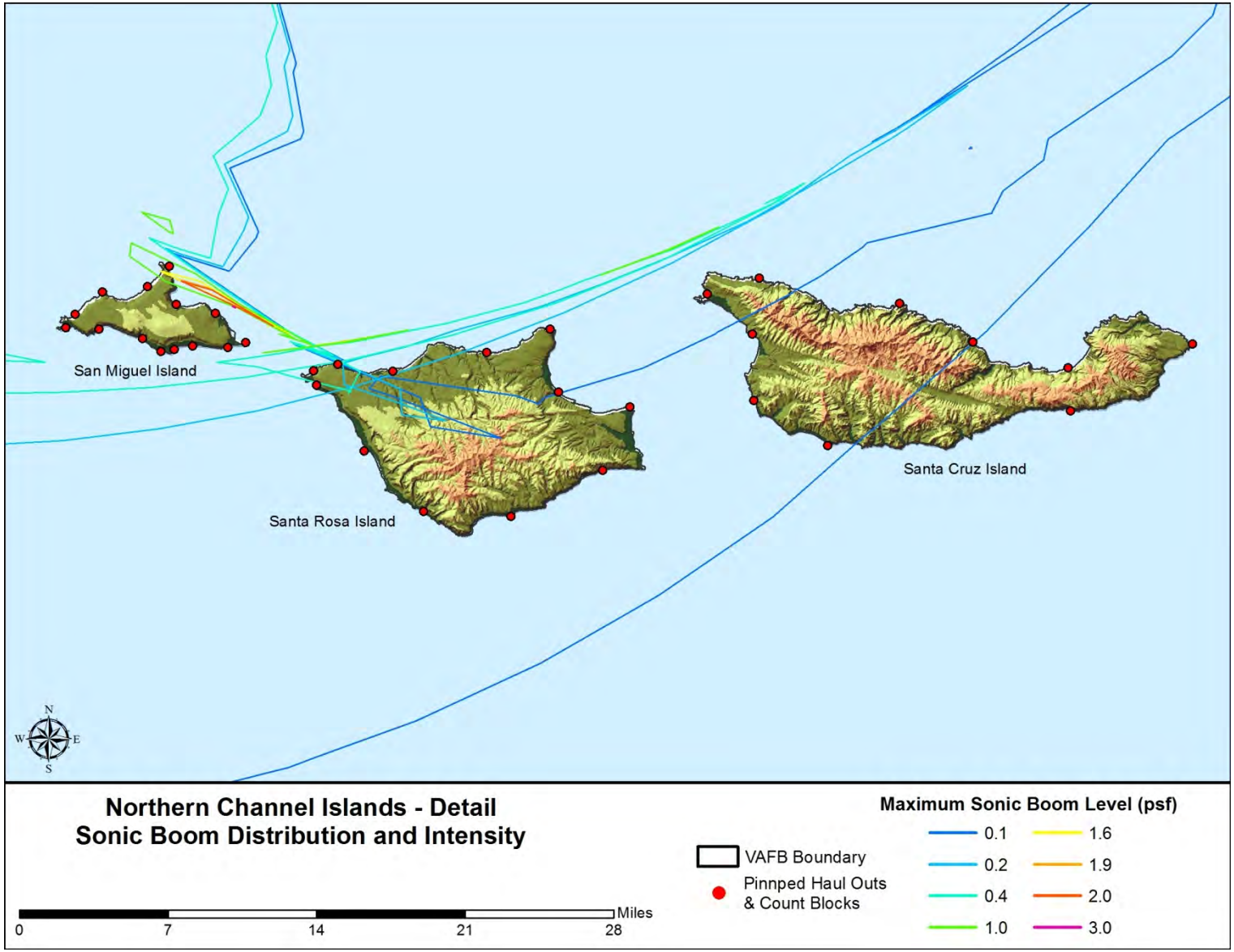


Figure 3-10. Marine Mammal Haul Outs on VAFB and Expected Sonic Boom Levels for SLC-4W Landing

3.3.6.3.4 Northern Elephant Seal (Mirounga angustirostris [Not Listed])

Northern elephant seals also haul-out sporadically on rocks and beaches along the coastline of VAFB. Therefore, there is the potential that northern elephant seals could haul out within the overflight zone of the Alternative 1 or Alternative 2. Noise levels from the First Stage landing may reach 80 dB at the haul-out sites (Figure 3-8), and sonic boom pressure levels could reach 2.0 psf (Figure 3-9). However, northern elephant seals do not pup on the VAFB coastline and observations of young of the year seals from May through November have represented individuals dispersing later in the year from other parts of the California coastline where breeding and birthing occur. 11 northern elephant seals were observed during aerial surveys of the Point Conception area by NOAA Fisheries in February of 2010 (Lowry 2015). Northern elephant seals breed and pup at the rookeries found at Point Bennett on the west end of San Miguel Island and at Cardwell Point on the east end of the island (Lowry 2002). During aerial surveys of the Northern Channel Islands conducted by NOAA Fisheries in February 2010, 21,192 total northern elephant seals (14,802 pups) were recorded at haul outs on San Miguel Island and 8,237 total (5,712 pups) were observed at Santa Rosa Island (Lowry 2015). None were observed at Santa Cruz Island (Lowry 2015). The at-sea estimate density for northern elephant seals is 0.05 individuals per km^2 in the contingency landing area of effect (U.S. Department of the Navy 2014a).

3.3.6.3.5 Steller Sea Lion (Eumetopias jubatus [Federal De-Listed Species])

North Rocky Point was used in April and May 2012 by Steller sea lions (Marine Mammal Consulting Group and Science Applications International Corporation 2013). This observation was the first time this species had been reported at VAFB during launch monitoring and monthly surveys conducted over the past two decades. Since 2012, Steller sea lions have been observed frequently in routine monthly surveys, with as many as 16 individuals recorded. In 2014, up to five Steller sea lions were observed in the affected area during monthly marine mammal counts (ManTech SRS Technologies, Inc. 2015a) and a maximum of 12 individuals were observed during monthly counts in 2015. Noise levels from the First Stage landing may reach 80 dB at the haul-out sites (Figure 3-8), and sonic boom pressure levels could reach 2.0 psf (Figure 3-9). Steller sea lions once had two small rookeries on San Miguel Island, but these were abandoned after the 1982-1983 El Niño event (DeLong and Melin 2000; Lowry 2002); however occasional juvenile and adult males have been detected since then. These rookeries were once the southernmost colonies of the eastern stock of this species. The Eastern Distinct Population Segment of this species, which includes the California coastline as part of its range, was de-listed from the federal ESA in November 2013. The at-sea estimate density for Steller sea lion is assumed to be 0.0001 individuals per km^2 in the contingency landing area of effect (U.S. Department of the Navy 2014a).

3.3.6.3.6 Northern Fur Seal (Callorhinus ursinus [Not Listed])

Two stocks of northern fur seals are recognized in United States waters: an eastern Pacific stock and a San Miguel Island stock (Carretta et al. 2015). The eastern Pacific stock is listed as depleted under the MMPA, while the San Miguel Island stock is protected under the MMPA but is not considered depleted (Carretta et al. 2015). Adult males stay on San Miguel Island from May through August, with some non-breeding individuals remaining until November. Adult females

generally stay from June to as late as November. Peak pupping is in early July. The pups are weaned at three to four months. Some juveniles are present year-round, but most juveniles and adults head for the open ocean and a pelagic existence until the next year. Animals found offshore of VAFB are most likely from the San Miguel Island stock, which remain in the area around San Miguel Island throughout the year (Koski et al. 1998). Northern fur seals have not been observed to haul out along the mainland coast of Santa Barbara County; however, one fur seal stranding has been reported at VAFB which involved a seal that came ashore at Surf Beach in 2012. The at-sea estimated density for Northern fur seal is 0.005 individuals per km^2 in the contingency landing area of effect (U.S. Department of the Navy 2014a).

3.3.6.3.7 Guadalupe Fur Seal (Arctocephalus townsendi [Federally Threatened Species])

The Guadalupe fur seal is listed as threatened under the ESA and depleted under the MMPA. Critical Habitat for the Guadalupe fur seal has not been designated for this species. As a result, the Proposed Action would not affect Critical Habitat for this species.

The Guadalupe fur seal is typically found on shores with abundant large rocks, often at the base of large cliffs. They are also known to inhabit caves, which provide protection and cooler temperatures, especially during the warm breeding season (Belcher and Lee 2002). They are rare in southern California, only found occasionally visiting the northern Channel Islands, as they mainly breed on Guadalupe Islands, Mexico, in the Months of May-July. On San Miguel Island, one to several Guadalupe fur seals were observed annually between 1969 and 2000 (DeLong and Melin 2000) and an adult female with a pup was observed in 1997 (Melin and Delong 1999). Over the past five years, two to three pups have been observed annually on San Miguel Island and 13 individuals and two pups were observed in 2015. Observations of adult males are rare on San Miguel Island and there have not been any breeding territories established (Harris 2015). Guadalupe fur seals can be found in deeper waters of the California Current Large Marine Ecosystem (Hanni et al. 1997; Jefferson et al. 2008). Guadalupe fur seals have not been observed hauling out on the mainland coast of Santa Barbara County. Adult males, juveniles, and nonbreeding females may live at sea during some seasons or for part of a season (Reeves et al. 1992). The movements of Guadalupe fur seals at sea are generally unknown, but strandings have been reported in northern California and as far north as Washington (Etnier 2002). A 1993 population estimate of all age classes in Mexico was 7,408 (Carretta et al. 2015). The estimated at-sea density of this species is assumed to be 0.007 individuals per km^2 in the affected area (U.S. Department of the Navy 2014a).

3.3.6.3.8 Humpback Whale (Megaptera novaeangliae [Federally Endangered Species])

Humpback whales are listed as depleted under the MMPA and endangered under the ESA. Based on evidence of population recovery in many areas, the species is being considered by NOAA Fisheries for removal or down-listing from the ESA (NOAA Fisheries 2009a). The California, Oregon, and Washington stock of humpback whales use the waters offshore of Southern California as a summer feeding ground. Peak occurrence occurs in Southern California waters from December through June (Calambokidis et al. 2001). During late summer, more humpback whales are sighted north of the Channel Islands, and limited occurrence is expected south of the northern Channel Islands (San Miguel, Santa Rosa, Santa Cruz) (Carretta et al. 2015). The at-sea estimated density for humpback whales is 0.02 individuals per km^2 in the contingency landing area of effect (U.S. Department of the Navy 2014a).

3.3.6.3.9 Blue Whale (Balaenoptera musculus [Federally Endangered Species])

The blue whale is listed as endangered under the ESA and as depleted under the MMPA. The blue whale inhabits all oceans and typically occurs near the coast, over the continental shelf, though it is also found in oceanic waters. Their range includes the California Current system (Ferguson 2005; Stafford et al. 2004). The U.S. Pacific coast is known to be a feeding area for this species during summer and fall (Bailey et al. 2009; Carretta et al. 2015). This species has frequently been observed in Southern California waters (Carretta et al. 2000, U.S. Department of the Navy 2011), and in the Southern California Bight, the highest densities of blue whales occurred along the 200 m isobath in waters with high surface chlorophyll concentrations (Redfern et al. in review). The at-sea estimated density for blue whales is 0.01 individuals per km^2 in the contingency landing area of effect (U.S. Department of the Navy 2014a).

3.3.6.3.10 Fin Whale (Balaenoptera physalus [Federally Endangered Species])

The fin whale is listed as endangered under the ESA and as depleted under the MMPA. This species has been documented from 60° N to 23° N, and they have frequently been recorded in offshore waters within the Southern California current system (Carretta et al. 2015; Mizroch et al. 2009). Aerial surveys conducted in October and November 2008 within Southern California offshore waters resulted in the sighting of 22 fin whales (Oleson and Hill 2009; Acevedo-Gutiérrez et al. 2002). Navy-sponsored monitoring in the Southern California Range Complex for the 2009–2010 period also recorded the presence of fin whales (U.S. Department of the Navy 2010). Moore and Barlow (2011) indicate that, since 1991, there is strong evidence of increasing fin whale abundance in the California Current area; they predict continued increases in fin whale numbers over the next decade. The at-sea estimated density for fin whales is 0.01 individuals per km^2 in the contingency landing area of effect (U.S. Department of the Navy 2014a).

3.3.6.3.11 Sei Whale (Balaenoptera borealis [Federally Endangered Species])

The sei whale is listed as endangered under the ESA and as depleted under the MMPA. Sei whales are distributed in offshore waters in the Southern California portion of the Study Area (Carretta et al. 2015). They are generally found feeding along the California Current (Perry et al. 1999). There are records of sightings in California waters as early as May and June, but primarily are encountered there during July to September and leave California waters by mid-October. The at-

sea estimated density for sei whales is 0.00009 individuals per km^2 in the contingency landing area of effect (U.S. Department of the Navy 2014a).

3.3.6.3.12 Bryde's Whale (Balaenoptera brydei/edeni [Not Listed])

Bryde's whales are protected under the MMPA and are not listed under the ESA. Bryde's whales are only occasionally sighted in the California Current Large Marine Ecosystems (Carretta et al. 2015; Jefferson et al. 2008). Aerial surveys conducted in October and November 2008 off the Southern California coast resulted in the sighting of one Bryde's whale (Smultea et al. 2012). This was the first sighting in this area since 1991 when a Bryde's whale was sighted within 345 mi. (555 km) of the California coast (Barlow 1995). The at-sea estimated density for Bryde's whales is 0.00001 individuals per km^2 in the contingency landing area of effect (U.S. Department of the Navy 2014a).

3.3.6.3.13 Minke Whale (Balaenoptera acutorostrata [Not Listed])

The minke whale is protected under the MMPA and is not listed under the ESA. Minke whales are present in summer and fall in Southern California waters (Carretta et al. 2009). They often use both nearshore and offshore waters as habitats for feeding and migration to wintering areas. The at-sea estimated density for minke whales is 0.0007 individuals per km^2 in the contingency landing area of effect (U.S. Department of the Navy 2014a).

3.3.6.3.14 Gray Whale (Eschrichtius robustus [Federally Endangered Species])

There are two North Pacific populations of gray whales: the Western subpopulation and the Eastern subpopulation. Both populations (stocks) could be present in Southern California waters during their northward and southward migration (Sumich and Show 2011). Both populations of gray whale are protected under the MMPA; the Western North Pacific stock is listed as endangered under the ESA and depleted under the MMPA. Eastern gray whales are frequently observed in Southern California waters (Carretta et al. 2000, Forney et al. 1995, Henkel and Harvey 2008, Hobbs et al. 2004). During aerial surveys off San Clemente Island, California, eastern gray whales were the most abundant marine mammal from January through April, a period that covers both the northward and southward migrations (Carretta et al. 2000, Forney et al. 1995). The at-sea estimated density for gray whales is 0.002 per km2 in the contingency landing area of effect (U.S. Department of the Navy 2014a).

3.3.6.3.15 Sperm Whale (Physeter microcephalus [Federally Endangered Species])

The sperm whale has been listed as endangered since 1970 under the precursor to the ESA (NOAA Fisheries 2009b), and is depleted under the MMPA. Sperm whales are found year round in California waters (Barlow 1995; Forney and Barlow 1993). Sperm whales are known to reach peak abundance from April through mid-June and from the end of August through mid-November (Carretta et al. 2015). The at-sea estimated density for sperm whales is 0.009 individuals per km^2 in the contingency landing area of effect (U.S. Department of the Navy 2014a).

3.3.6.3.16 Pygmy Sperm Whale (Kogia breviceps [Not Listed])

The pygmy sperm whale is protected under the MMPA but is not listed under the ESA. Pygmy sperm whales apparently occur close to shore, sometimes over the outer continental shelf. However, several studies have suggested that this species generally occurs beyond the continental shelf edge (Bloodworth and Odell 2008; MacLeod et al. 2004). A total of two sightings of this species have been made in offshore waters along the California coast during previous surveys (Carretta et al. 2015). The at-sea estimated density for pygmy sperm whales is 0.001 individuals per km^2 in the contingency landing area of effect (U.S. Department of the Navy 2014a).

3.3.6.3.17 Dwarf Sperm Whale (Kogia sima [Not Listed])

The dwarf sperm whale is protected under the MMPA and is not listed under the ESA. Along the U.S. Pacific coast, no reported sightings of this species have been confirmed as dwarf sperm whales. This may be somewhat due to their pelagic distribution, cryptic behavior (i.e., "hidden" because they are not very active at the surface and do not have a conspicuous blow), and physical similarity to the pygmy sperm whale (Jefferson et al. 2008, McAlpine 2009). However, the presence of dwarf sperm whales off the coast of California has been demonstrated by at least five dwarf sperm whale strandings in California between 1967 and 2000 (Carretta et al. 2015). The at-sea estimated density for dwarf sperm whales is 0.001 individuals per km^2 in the contingency landing area of effect (U.S. Department of the Navy 2014a).

3.3.6.3.18 Killer Whale (Orcinus orca [Not Listed])

The killer whale is protected under the MMPA, and the overall species is not listed on the ESA. The southern resident population in Puget Sound (not found in the landing area) is listed as endangered under the ESA and is depleted under the MMPA. Along the Pacific coast of North America, killer whales are known to occur (from stranding records and acoustic detection) along the outer coasts of Washington, Oregon, and California (Calambokidis and Barlow 2004, Dahlheim et al. 2008, Ford and Ellis 1999, Forney et al. 1995). Although they are not commonly observed in Southern California coastal areas, killer whales are found year round off the coast of Baja California (Carretta et al. 2015; Forney et al. 1995). The at-sea estimated density for killer whales is 0.0007 individuals per km^2 in the contingency landing area of effect (U.S. Department of the Navy 2014a).

3.3.6.3.19 Short-finned Pilot Whale (Globicephala macrorhynchus [Not Listed])

Short-finned pilot whales are protected under the MMPA and are not listed under the ESA. Along the U.S. Pacific coast, short-finned pilot whales are most abundant south of Point Conception (Carretta et al. 2015; Reilly and Shane 1986) in deep offshore waters over the continental shelf break, in slope waters, and in areas of high topographic relief (Olson 2009). A few hundred pilot whales are believed to group each winter at Santa Catalina Island (Carretta et al. 2015; Reilly and Shane 1986), although these animals are not seen as regularly as in previous years. The at-sea estimated density for short-finned pilot whales is 0.0003 individuals per km^2 in the contingency landing area of effect (U.S. Department of the Navy 2014a).

3.3.6.3.20 Long-beaked Common Dolphin (Delphinus capensis [Not Listed])

Long-beaked common dolphins are protected under the MMPA and are not listed under the ESA. The long-beaked common dolphin's range within California Current waters is considered to be within about 57.5 mi. (92.5 km) of the coast, from Baja California north through central California. Stranding data and sighting records suggest that this species' abundance fluctuates seasonally and from year to year off California (Carretta et al. 2015; Zagzebski et al. 2006). It is found off Southern California year round, but it may be more abundant there during the warm-water months (May to October) (Bearzi 2005a, 2005b; Carretta et al. 2015). The long-beaked common dolphin is not a migratory species, but seasonal shifts in abundance (mainly inshore/offshore) are known for some regions of its range. The at-sea estimated density for long-beaked common dolphins is 0.69 individuals per km^2 in the contingency landing area of effect (U.S. Department of the Navy 2014a).

3.3.6.3.21 Short-beaked Common Dolphin (Delphinus delphis [Not Listed])

Short-beaked common dolphins are protected under the MMPA and are not listed under the ESA. Along the U.S. Pacific coast, short-beaked common dolphin distribution overlaps with that of the long-beaked common dolphin. Short-beaked common dolphins are found in California Current waters throughout the year, distributed between the coast and at least 345 mi. (555 km) from shore (Carretta et al. 2015; Forney and Barlow 1998). Although they are not truly migratory, the abundance of the short-beaked common dolphin off California varies, with seasonal and year-to-year changes in oceanographic conditions; movements may be north-south or inshore-offshore (Barlow 1995; Carretta et al. 2015; Forney and Barlow 1998). The at-sea estimated density for short-beaked common dolphins is 1.3 individuals per km^2 in the contingency landing area of effect (U.S. Department of the Navy 2014a).

3.3.6.3.22 Common Bottlenose Dolphin (Tursiops truncates [Not Listed])

The common bottlenose dolphin is protected under the MMPA and is not listed under the ESA. During surveys off California, offshore bottlenose dolphins were generally found at distances greater than 1.9 mi. (3.06 km) from the coast and throughout the southern portion of California Current waters (Bearzi et al. 2009; Carretta et al. 2015). Sighting records off California and Baja California suggest continuous distribution of offshore bottlenose dolphins in these regions. Aerial surveys during winter/spring 1991–1992 and shipboard surveys in summer/fall 1991 indicated no seasonality in distribution (Barlow 1995; Carretta et al. 2015; Forney et al. 1995). In the North Pacific, common bottlenose dolphins have been documented in offshore waters as far north as about 41° N (Carretta et al. 2015). The at-sea estimated density for common bottlenose dolphins is 0.71 individuals per km^2 in the contingency landing area of effect (U.S. Department of the Navy 2014a).

3.3.6.3.23 Striped Dolphin (Stenella coeruleoalba [Not Listed])

The striped dolphin is protected under the MMPA and is not listed under the ESA. In and near California waters, striped dolphins are found mostly offshore and are much more common during the warm-water period (summer/fall), although they are found there throughout the year. During summer/fall surveys, striped dolphins were sighted primarily from 115 to 345 mi. (185 to

555 km) offshore of the California coast. Based on sighting records, striped dolphins appear to have a continuous distribution in offshore waters from California to Mexico (Carretta et al. 2015). The at-sea estimated density for striped dolphins is 0.03 individuals per km^2 in the contingency landing area of effect (U.S. Department of the Navy 2014a).

3.3.6.3.24 Pacific White-sided Dolphin (Lagenorhynchus obliquidens [Not Listed])

The Pacific white-sided dolphin is not listed under the ESA but is protected under the MMPA. Primary habitat includes the cold temperate waters of the North Pacific Ocean and deep ocean regions. They range as far south as the mouth of the Gulf of California, northward to the southern Bering Sea and coastal areas of southern Alaska (Leatherwood et al. 1984; Jefferson et al. 2008). Off California, Forney and Barlow (1998) found significant north/south shifts in the seasonal distribution of Pacific white-sided dolphin, with the animals moving north into Oregon and Washington waters during the summer, and showing increased abundance in the Southern California Bight in the winter. Off California, the species is found mostly at the outer edge of the continental shelf and slope and does not frequently move into shallow coastal waters. Although Pacific white-sided dolphins do not migrate, seasonal shifts have been documented as noted above. From November to April, Pacific white-sided dolphins can be found in shelf waters off the coast of Southern California. The at-sea estimated density for Pacific white-sided dolphins is 0.75 individuals per km^2 in the contingency landing area of effect (U.S. Department of the Navy 2014a).

3.3.6.3.25 Northern Right Whale Dolphin (Lissodelphis borealis [Not Listed])

The northern right whale dolphin is not listed under the ESA but is protected by the MMPA. This species is known to occur year round off of California, but abundance and distribution vary seasonally. This species is most abundant off central and northern California in relatively nearshore waters in winter (Dohl et al. 1983). In the cool water period, the peak abundance of northern right whale dolphins in Southern California waters corresponds closely with the peak abundance of squid (Forney and Barlow 1998). In the warm water period, the northern right whale dolphin is not as abundant in Southern California waters due to shifting distributions north into Oregon and Washington, as water temperatures increase (Barlow 1995; Forney and Barlow 1998; Leatherwood and Walker 1979).The at-sea estimated density for northern right whale dolphins is 0.107 individuals per km^2 in the contingency landing area of effect (U.S. Department of the Navy 2014a).

3.3.6.3.26 Risso's Dolphin (Grampus griseus [Not Listed])

Risso's dolphin is protected under the MMPA and is not listed under the ESA. Off California, they are commonly seen over the slope and in offshore waters (Caretta et al. 2015; Forney et al. 1995; Jefferson et al. 2008). This species is frequently observed in the waters surrounding San Clemente Island, California. They are generally present year round in Southern California, but are more abundant in the cold-water months, suggesting a possible seasonal shift in distribution (Carretta et al. 2000; Soldevilla 2008). Several stranding records have been documented for this species in central and Southern California between 1977 and 2002 (Zagzebski et al. 2006). The at-sea

estimated density for Risso's dolphins is 0.20 individuals per km^2 in the contingency landing area of effect (U.S. Department of the Navy 2014a).

3.3.6.3.27 Dall's Porpoise (Phocoenoides dalli [Not Listed])

The Dall's Porpoise is protected under the MMPA and is not listed under the ESA. In Southern California waters, Dall's porpoises are sighted seasonally, mostly during the winter (Carretta et al. 2015). Inshore/offshore movements off Southern California have been reported, with individuals remaining inshore in fall and moving offshore in the late spring (Houck and Jefferson 1999). The at-sea estimated density for Dall's dolphins is 0.06 individuals per km^2 in the contingency landing area of effect (U.S. Department of the Navy 2014a).

3.3.6.3.28 Cuvier's Beaked Whale (Ziphius cavirostris [Not Listed])

Cuvier's beaked whale is protected under the MMPA and is not listed under the ESA. Cuvier's beaked whale is the most commonly encountered beaked whale off the eastern North Pacific Coast. There are no apparent seasonal changes in distribution, and this species is found from Alaska to Baja California, Mexico (Carretta et al. 2015; Mead 1989; Pitman et al. 1988). However, Mitchell (1968) reported strandings, from Alaska to Baja California, to be most abundant between February and September. Repeated sightings of the same individuals have been reported off San Clemente Island in Southern California, which indicates some level of site fidelity (Falcone et al. 2009). The at-sea estimated density for Cuvier's beaked whales is 0.005 individuals per km^2 in the contingency landing area of effect (U.S. Department of the Navy 2014a).

3.3.6.3.29 Baird's Beaked Whale (Berardius bairdii [Not Listed])

Baird's beaked whale is protected under the MMPA and is not listed under the ESA. The continental shelf margins from the California coast to 125° West (W) longitude were recently identified as key areas for beaked whales (MacLeod and D'Amico 2006). Baird's beaked whale is found mainly north of 28° N in the eastern Pacific (Kasuya and Miyashita 1997; Reeves et al. 2003). Along the West Coast, Baird's beaked whales are seen primarily along the continental slope, from late spring to early fall (Carretta et al. 2015; Green et al. 1992). Baird's beaked whales are sighted less frequently and are presumed to be farther offshore during the colder water months of November through April (Carretta et al. 2015). The at-sea estimated density for Baird's beaked whales is 0.0015 individuals per km^2 in the contingency landing area of effect (U.S. Department of the Navy 2014a).

3.3.6.3.30 Blainville's Beaked Whale (Mesoplodon densirostris [Not Listed])

Blainville's beaked whale is protected under the MMPA and is not listed under the ESA. There are a handful of known records of the Blainville's beaked whale from the coast of California and Baja California, Mexico, but the species does not appear to be common in California waters (Carretta et al. 2015; Mead 1989; Pitman et al. 1988). The at-sea estimated density for Blainville's beaked whales is 0.0001 individuals per km^2 in the contingency landing area of effect (U.S. Department of the Navy 2014a).

3.3.6.3.31 Ginko-toothed Beaked Whale (Mesoplodon ginkgodens [Not Listed])

The ginkgo-toothed beaked whale is protected under the MMPA and is not listed under the ESA. The distribution of the ginkgo-toothed beaked whale likely includes the California Current system North Pacific Gyre. The handful of known records of the ginkgo-toothed beaked whale are from strandings, one of which occurred in California (Jefferson et al. 2008; MacLeod and D'Amico 2006). The at-sea estimated density for Ginko-toothed beaked whales is 0.0003 individuals per km^2 in the contingency landing area of effect (U.S. Department of the Navy 2014a).

3.3.6.3.32 Perrin's Beaked Whale (Mesoplodon perrini [Not Listed])

Perrin's beaked whale is protected under the MMPA and is not listed under the ESA. Perrin's beaked whale range generally includes the California Current system and North Pacific Gyre (MacLeod et al. 2006). Perrin's beaked whale is known only from five stranded specimens along the California coastline (Dalebout et al. 2002; MacLeod et al. 2006). Regional distribution and abundance within the California Current system have not been estimated to date, due to scarcity of data. Known records of this species come from five strandings from 1975 to 1997. These strandings include two at U.S. Marine Corps Base Camp Pendleton, and one each at Carlsbad, Torrey Pines State Reserve, and Monterey (Dalebout et al. 2002; Mead 1981), all of which are in California. The at-sea estimated density for Perrin's beaked whales is 0.001 individuals per km^2 in the contingency landing area of effect (U.S. Department of the Navy 2014a).

3.3.6.3.33 Stejneger's Beaked Whale (Mesoplodon stejnegeri [Not Listed])

Stejneger's beaked whale is protected under the MMPA and is not listed under the ESA. This species may be found in the California Current system and has an assumed preference for colder water (Jefferson et al. 2008; MacLeod et al. 2006). The southern limit in the central Pacific is unknown but is likely to range between 50° N and 60° N, and 30° N (Loughlin and Perez 1985; MacLeod et al. 2006). The at-sea estimated density for Stejneger's beaked whales is 0.001 individuals per km^2 in the contingency landing area of effect (U.S. Department of the Navy 2014a).

3.3.6.3.34 Hubbs' Beaked Whale (Mesoplodon carlhubbsi [Not Listed])

Hubbs' beaked whale is protected under the MMPA and is not listed under the ESA. MacLeod et al. (2006) speculated that the distribution might be continuous across the north Pacific between about 30° N and 45° N, but this remains to be confirmed. Mead (1989) speculated that the Hubbs' beaked whales' range includes the northernmost central California coastline. The at-sea estimated density for Hubbs' beaked whales is 0.001 individuals per km^2 in the contingency landing area of effect (U.S. Department of the Navy 2014a).

3.3.6.3.35 Pygmy Beaked Whale (Mesoplodon peruvianus [Not Listed])

The pygmy beaked whale is protected under the MMPA and is not listed under the ESA. Pygmy beaked whales normally inhabit continental slope and deep oceanic waters (greater than 656 ft. [200 m]) and are only occasionally reported in waters over the continental shelf (Canadas et al. 2002; Ferguson et al. 2006; MacLeod et al. 2006; Pitman 2008; Waring et al. 2001). Based on stranding data from the Pacific coast of Mexico, the range of the pygmy beaked whale generally

includes the California Current system and North Pacific Gyre (Aurioles and Urban-Ramirez 1993; Jefferson et al. 2008; Urban-Ramirez and Aurioles-Gamboa 1992). The at-sea estimated density for Pygmy beaked whales is 0.0003 individuals per km^2 in the contingency landing area of effect (U.S. Department of the Navy 2014a).

3.3.7 Sensitive Marine Habitats

3.3.7.1 Region of Influence

The ROI for sensitive marine habitats includes marine areas that would potentially be affected by potential impacts of the Proposed Action, primarily acoustic impacts (Figures 2-4, 2-5, 2-9, 2-10, and 2-12), but also by expended materials in the vicinity of the contingency landing location.

3.3.7.2 Essential Fish Habitat

In 1996, the Magnuson-Stevens Fishery Conservation and Management Act (MSA) was reauthorized and amended by the Sustainable Fisheries Act (Public Law 104-267). The reauthorized MSA mandated numerous changes to the existing legislation designed to prevent overfishing, rebuild depleted fish stocks, minimize bycatch, enhance research, improve monitoring, and protect fish habitat. One of the most significant mandates in the MSA that came out of the reauthorization was the EFH provision, which provides the means to conserve fish habitat.

The EFH mandate requires that the regional Fishery Management Councils, through federal fishery management plans, describe and identify EFH for each federally managed species; minimize, to the extent practicable, adverse effects on such habitat caused by fishing; and identify other actions to encourage the conservation and enhancement of such habitats. Congress defines EFH as “those waters and substrate necessary to fish for spawning, breeding, feeding, or growth to maturity” (16 U.S.C. §1802(10). The term “fish” is defined in the MSA as “finfish, mollusks, crustaceans, and all other forms of marine animals and plant life other than marine mammals and birds.” The regulations for implementing EFH clarify that “waters” include all aquatic areas and their biological, chemical, and physical properties, while “substrate” includes the associated biological communities that make these areas suitable fish habitats (50 C.F.R. §600.10). Habitats used at any time during a species’ life cycle (i.e., during at least one of its lifestages) must be accounted for when describing and identifying EFH.

Authority to implement the MSA is given to the Secretary of Commerce through NOAA Fisheries. The MSA requires that EFH be identified and described for each federally managed species. The MSA also requires federal agencies to consult with NOAA Fisheries on activities that may adversely affect EFH or when the NOAA Fisheries independently learns of a federal activity that may adversely affect EFH. The MSA defines an adverse effect as “any impact that reduces quality and/or quantity of EFH. Adverse effects may include direct or indirect physical, chemical, or biological alterations of the waters or substrate and loss of, or injury to, benthic organisms, prey species and their habitat, and other ecosystem components, if such modifications reduce the quality and/or quantity of EFH. Adverse effects to EFH may result from actions occurring within

EFH or outside of EFH and may include site-specific or habitat-wide impacts, including individual, cumulative, or synergistic consequences of actions" (50 C.F.R. §600.810).

The contingency landing area under Alternative 1 is located within EFH for federally managed fish species within the Pacific Coast Groundfish, Coastal Pelagic Species, and Highly Migratory Species Management Plans, as shown in Figure 3-11. The Proposed Action is also located approximately 2.5 mi. (4 km) and 12.6 mi. (20.3 km) from the Point Conception and East San Lucia Bank EFH Conservation Areas, respectively (Figure 3-11).

In addition to EFH designations, areas called Habitat Areas of Particular Concern (HAPC) are also designated by the Regional Fishery Management Councils. Designated HAPCs are discrete subsets of EFH which are rare, particularly vulnerable to human-induced degradation, provide extremely important ecological functions, or located in an environmentally stressed area (50 C.F.R. §600.805–600.815). Categorization of an area as a HAPC does not confer additional protection or restriction to the designated area.

Kelp, rocky reef, and seagrass habitats are designated as HAPC for various federally managed fish species within the Pacific Coast Groundfish Fishery Management Plans. The nearest kelp habitat is located offshore of SLC-4W, while the nearest rocky reef habitat is located approximately 10 mi. (16.1 km) north-northeast of the contingency drone ship landing site. Seagrass beds are located along the coastline of VAFB or within coastal estuaries.

3.3.7.3 Critical Habitat – Leatherback Sea Turtle

Critical Habitat for the leatherback sea turtle was designated in California waters from Point Arena south to Point Arguello in 2012 (77 FR 4170). The contingency landing location of Alternative 1 is approximately 6.2 mi. (10 km) south of this Critical Habitat (Figure 3-12). The only primary constituent element for leatherback sea turtles in this Critical Habitat is the occurrence of prey species of sufficient condition, distribution, diversity, abundance, and density necessary for growth and success of leatherback sea turtles (NOAA Fisheries 2012). The Proposed Action would not affect the leatherback sea turtle's prey, and therefore would not affect its Critical Habitat.

3.3.7.4 Marine Reserves

Under the National Marine Sanctuaries Act, NOAA established national marine sanctuaries for marine areas with special conservation, recreational, ecological, historical, cultural, archaeological, scientific, educational, or aesthetic qualities. The Channel Islands National Marine Sanctuary (CINMS) is a collection of marine reserves and marine sanctuaries located at the Channel Islands approximately 40 mi. (65 km) south of SLC-4W (Figures 3-13 and 3-14). CINMS regulations listed in 15 C.F.R. 922.71 - 922.74. Section 922.72(a)(1) prohibits taking any marine mammal, sea turtle, or seabird within or above the CINMS, except as authorized by the MMPA, ESA, MBTA, or any regulation promulgated under the MMPA, ESA, or MBTA. Both the boost-back and landing of the Falcon 9 Full Thrust First Stage at SLC-4W and the contingency landing location 31 mi. (50 km) offshore would produce a sonic boom at or slightly above 3.0 psf within the CINMS.

In addition, the coastline from Purisima Point to just north of Point Arguello (Figures 3-13 and 3-14) has been designated as the Vandenberg State Marine Reserve (VSMR) pursuant to the Marine Managed Areas Improvement Act. The VSMR management objectives include providing for complete protection of a diverse area containing shallow hard and soft habitats, kelp beds, and associated marine life. The project area overlaps the VSMR and a sonic boom up to 2 psf is expected within this reserve.

3.4 Water Resources

Water resources and wetlands of the U.S. include surface water and groundwater and their physical, chemical, and biological characteristics. Under Section 404 of the Clean Water Act (CWA), wetlands are defined as areas that are "inundated or saturated by surface or ground water at a frequency and duration sufficient to support, and that under normal circumstances do support, a prevalence of vegetation typically adapted for life in saturated soil conditions." Surface water includes lakes, rivers, streams, and wetlands, while groundwater refers to water below the surface. Industrial or hazardous waste management, as it applies to water resources, is also discussed in this section. The CWA establishes the structure for regulating discharges of pollutants in Waters of the U.S. The CWA mandates the NPDES program, which requires a permit for the discharge of any pollutant to Waters of the U.S. from point and non-point sources. Point sources include wastewater from any discernible confined and discrete conveyances from which pollutants are or may be discharged. Non-point sources include stormwater runoff from industrial, municipal, and construction sites. The CWA and implementing USEPA regulations provide the authority and framework for state regulations. In California, the SWRCB administers the NPDES program through the Porter Cologne Water Quality Act/California Water Code. The SWRCB and the Regional Water Quality Control Board (RWQCB) administers the NPDES Program for industrial activities, municipalities and construction activities through General Permits, although certain discharges are authorized and certain discharges require individual permits. VAFB is in the jurisdiction of the Region 3, Central Coast RWQCB.

3.4.1 Region of Influence

The ROI for Water Resources include those areas where surface water, groundwater, wetlands and Waters of the U.S. may be potentially affected by the Proposed Action. This includes the construction area at SLC-4W where ground-disturbing activities would take place (Figure 2-1), as well as adjacent areas that may be impacted by construction, operation, and implementation of the Proposed Action. For surface water resources, the ROI includes Spring Canyon Creek and the Pacific Ocean. For groundwater resources, the ROI includes the Santa Ynez River groundwater basin/Lompoc Terrace sub-basin. There are no jurisdictional Waters of the U.S. or wetlands within the construction area or area affected by the boost-back operations of the Falcon 9 Full Thrust First Stage.

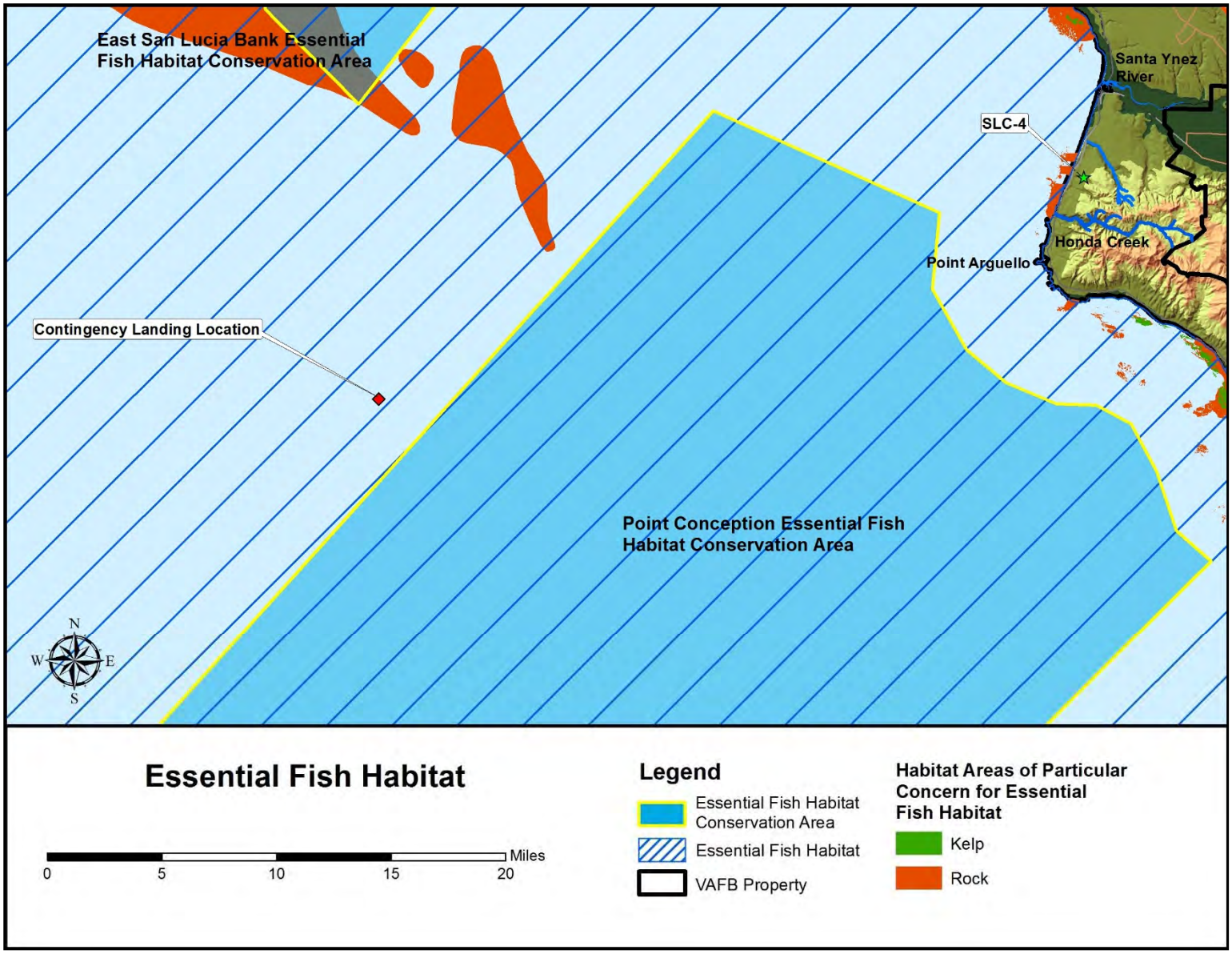


Figure 3-11. Essential Fish Habitat Within the Project Area

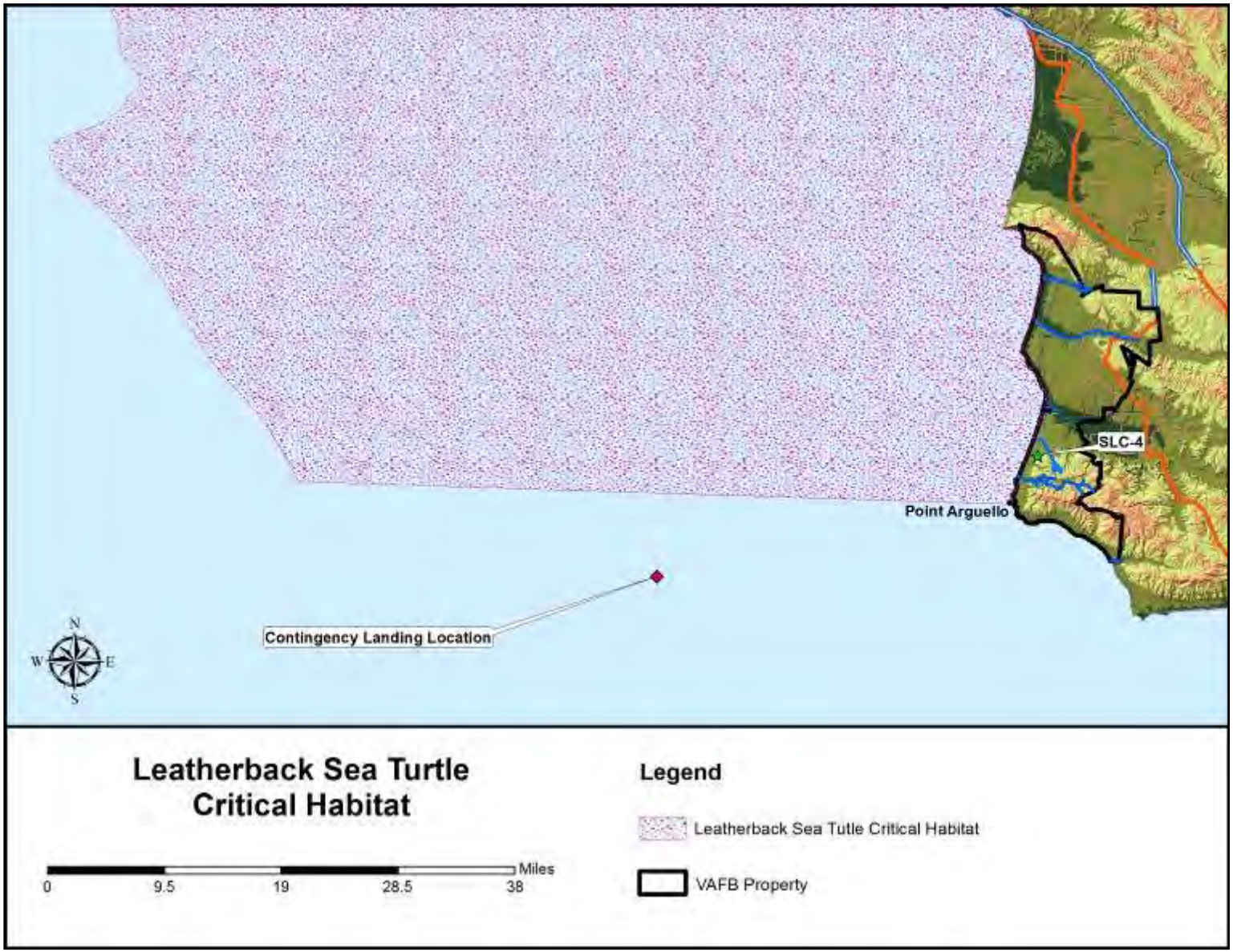


Figure 3-12. Leatherback Sea Turtle Critical Habitat

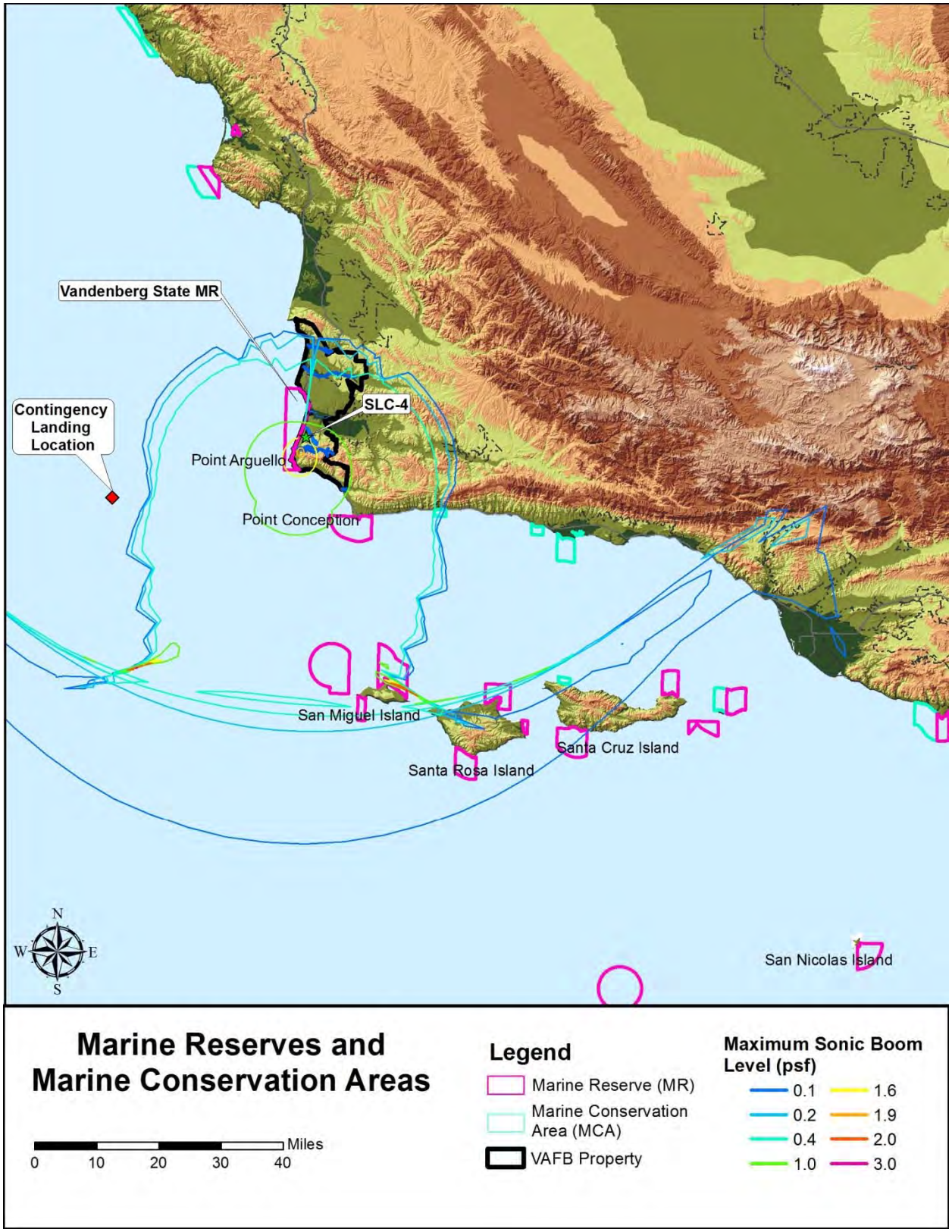


Figure 3-13. Marine Reserves and Marine Conservation Areas Impacted by Sonic Boom as a Result of Falcon 9 Boost-Back and Landing at SLC-4W

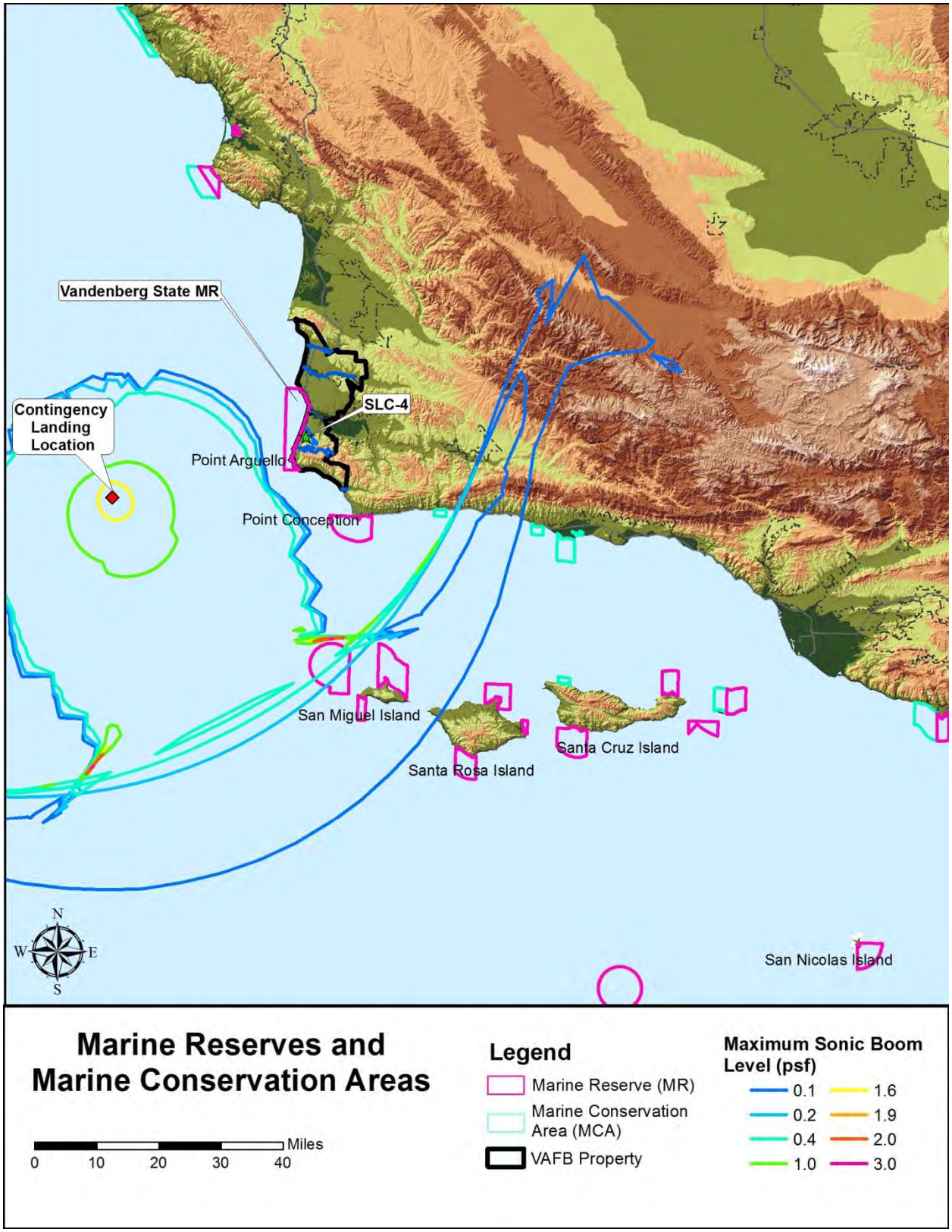


Figure 3-14. Marine Reserves and Marine Conservation Areas Impacted by Sonic Boom as a Result of Falcon 9 Boost-Back and Landing at the Contingency Landing Location

3.4.2 Surface Water

The California Porter-Cologne Water Quality Act provides a framework for establishing beneficial uses of water resources and the development of local water quality objectives to protect these beneficial uses. The Central Coast Water Quality Control Plan (Basin Plan) assigns beneficial uses to water bodies and provides local water quality objectives to protect these beneficial uses. The California Ocean Plan provides water quality objectives to protect ocean water quality. The Santa Ynez River is considered the dividing line between North and South VAFB. Three major drainages occur on south VAFB: Bear Creek, Cañada Honda Creek, and Jalama Creek. There are also numerous unnamed minor drainage basins containing seasonal and ephemeral streams. Drainage from these basins is predominantly to the west, toward the Pacific Ocean. Surface water resources in the vicinity of SLC-4W include Spring Canyon Creek and the Pacific Ocean. Spring Canyon Creek, approximately 0.1 mi. (0.2 km) south of SLC-4W, originates approximately 1.4 mi. (2.3 km) inland and flows toward the ocean. Lower Spring Canyon is an ephemeral creek that often has standing water upstream of Surf Road. Surface flow percolates into the groundwater to pass beneath road embankments and eventually enters the Pacific Ocean. Lower Spring Canyon was sampled during the VAFB Ambient Monitoring Program from December 2005 to December 2006. Low flow and highly saturated soil conditions were causing anaerobic decomposition, suppressing the dissolved oxygen and pH levels. The results for metals exceeded the criteria in 13 of 20 metals analyzed (Vandenberg Air Force Base 2006). There was also a large amount of leaf litter that appeared to be decomposing into a thick, orange substance.

3.4.3 Groundwater

VAFB includes parts of two major groundwater basins, and at least two sub-basins. Most of the northern third of the Base is within the San Antonio Creek Basin, while most of the southern two-thirds of the Base are within the Santa Ynez River Basin and associated Lompoc Terrace and Cañada Honda sub-basins. SLC-4W is located on the southern margin of the Santa Ynez River groundwater basin/Lompoc Terrace sub-basin. Groundwater at the site is unconfined and restricted to the unconsolidated material immediately above Sisquoc Formation bedrock. An erosional paleomarine terrace of Sisquoc shale bedrock has been noted within Spring Canyon and the launch pad area. The bedrock surface has been affected by interaction with groundwater resulting in a physical and chemical change from shale to clay. The weathered clay bedrock effectively forms an aquitard, thereby limiting the infiltration of groundwater into the underlying Sisquoc Formation. Groundwater is typically found approximately 50 to 140 ft. below ground surface. Predominant groundwater flow is toward the Pacific Ocean (U.S. Air Force 1988).

Previous launch operations at SLC-4W resulted in the release of hazardous materials to the environment, which has resulted in volatile organic compounds (VOCs) and perchlorate contaminating groundwater at the site (see Section 3.8.5, Environmental Restoration Program at VAFB).

3.4.4 Wetlands and Waters of the United States

Waters of the U.S. most commonly encompass navigable waters bound by the ordinary high water line, adjacent wetlands, relatively permanent tributaries and territorial seas. Wetlands

generally include swamps, marshes, bogs, and similar areas (EPA, 40 C.F.R. 230.3 and U.S. Army Corps of Engineers, 33 C.F.R. 328.3). EO 11990, dated 24 May 1977 and amended by EO 12608 on 9 September 1987, requires federal agencies to minimize the destruction, loss, or degradation of wetlands and to enhance their natural and beneficial values. Territorial waters, defined by the 1982 United Nations Convention on the Law of the Sea, extend 12 nautical mi. (13.8 mi.; 22.2 km) from the mean low-water mark of a coastal state.

There are no jurisdictional wetlands within the construction area or area affected by the boost-back operations of the Falcon 9 Full Thrust First Stage as described in the Proposed Action and identified alternatives. Under Alternative 1, the First Stage would fly over jurisdictional wetlands on South VAFB, but not have any ground-disturbing effects. Under the Alternative 1 contingency action, Alternative 2, and the No Action Alternative, the First Stage would land in the Pacific Ocean, outside of the 13.8 mi. (22.2 km) boundary of territorial waters. Therefore, Alternative 1, Alternative 2, and the No Action Alternative would not have any effect on jurisdictional wetlands or Waters of the U.S.

3.5 Cultural Resources

Cultural resources are districts, buildings, sites, structures, areas of traditional use, or objects with historical, architectural, archeological, cultural, or of scientific importance. They include archeological resources (both prehistoric and historic), historic architectural resources (physical properties, structures, or built items), and traditional cultural properties (those important to living Native Americans for religious, spiritual, ancestral, or traditional reasons).

3.5.1 Region of Influence

The ROI for Cultural Resources is the SLC-4W construction area where ground-disturbing activities would take place. The prehistory of California's central coast spans the entire Holocene and may extend back to late Pleistocene times. Excavations on VAFB reveal occupations dating back 11,000 years (Lebow et al. 2014). These early occupants are thought to have lived in small groups that had a relatively egalitarian social organization and a forager-type land-use strategy (Erlandson 1994; Glassow 1996; Greenwood 1972; Moratto 1984). Human population density was low throughout the early and middle Holocene (Lebow et al. 2007). Cultural complexity appears to have increased around 3,000–2,500 years ago (King 1981, 1990). At VAFB, that interval also marks the beginning of increasing human population densities and appears to mark the shift from a foraging to a collecting land-use strategy (Lebow et al. 2006, 2007). Population densities reached their peak around 600–800 years ago, corresponding to the full emergence of Chumash cultural complexity (Arnold 1992).

People living in the VAFB area prior to historic contact are grouped with the Purisima Chumash (Greenwood 1978; King 1984; Landberg 1965), one of several linguistically related members of the Chumash culture. In the Santa Barbara Channel area, the Chumash people lived in large, densely populated villages and had a culture that "was as elaborate as that of any hunter-gatherer society on earth" (Moratto 1984). Relatively little is known about the Chumash in the Vandenberg region. Explorers noted that villages were smaller and lacked the formal structure found in the channel area (Greenwood 1978). About five ethnohistoric villages are identified by

King (1984) on VAFB, along with another five villages in the general vicinity. Diseases introduced by early Euroamerican explorers, beginning with the maritime voyages of Cabrillo in A.D. 1542–1543, substantially impacted Chumash populations more than 200 years before Spanish occupation began (Erlandson and Bartoy 1995, 1996; Preston 1996). Drastic changes to Chumash lifeways resulted from the Spanish occupation that began with the Portolá expedition in A.D. 1769.

VAFB history is divided into the Mission, Rancho, Anglo-Mexican, Americanization, Regional Culture, and Suburban periods. The Mission Period began with the early Spanish explorers and continued until 1820. Mission La Purísima encompassed the Vandenberg area. Farming and ranching were the primary economic activities at the Mission. The Rancho Period began in 1820 and continued until 1845. Following secularization in 1834, the Alta California government granted former mission lands to Mexican citizens as ranchos. Cattle ranching was the primary economic activity during this period. The Bear Flag Revolt and the Mexican War marked the beginning of the Anglo-Mexican Period (1845–1880). Cattle ranching continued to flourish during the early part of this period, but severe droughts during the 1860s decimated cattle herds. The combination of drought and change in government from Mexican to the United States caused substantial changes in land ownership. Sheep ranching and grain farming replaced the old rancho system. Increased population densities characterize the Americanization Period (1880–1915). Beginning in the late 1890s, the railroad provided a more efficient means of shipping and receiving goods and supplies, which in turn increased economic activity. Ranching and farming continued during the early part of the period of Regional Culture (1915–1945), until property was condemned for Camp Cooke (Palmer 1999).

The Suburban Period (1945–1965) began with the end of World War II. In 1956, the army transferred 64,000 ac. of North Camp Cooke to the USAF, and it was renamed the Cooke Air Force Base. Construction of missile launch complexes began in 1957 and in 1958 the base had its first missile launch, the Thor, and was renamed VAFB (Palmer 1999). The base played a very important role in the Cold War, with every ballistic missile in the United States arsenal ground- and flight-tested at VAFB and thousands of military personnel receiving training under operational conditions. In addition, the base was the only place where military satellites could be safely launched into polar orbit and, thus, proved critical to the military space program during the Cold War (Nowlan et al. 1996).

3.5.2 Cultural Resources within the Project Area

Most of the cultural resources studies in the general vicinity of SLC-4 have been outside of the complex boundary; only a small part of the launch complex itself has been surveyed for archaeological resources. Most previous surveys within SLC-4 have been linear and include one for a security clear zone (Stone and Haley 1981); one for a fiber-optic cable project (Environmental Solutions et al. 1988); another for a fiber optic cable project (Bergin 1989); and one for a power line (Berry 1989). Undisturbed portions of SLC-4E were surveyed in conjunction with SpaceX's Falcon 9 Program (Lebow 2010).

Within SLC-4W, a survey was completed in 2010 prior to an investigation of hazardous soil contaminants resulting from past launch activities. The survey encompassed an area of about 1

ac. (0.004 km^2) immediately around and extending south (downslope) from the former launch pad at SLC-4W (Cote 2010). In addition to archaeological surveys, detailed archaeological excavations have been completed at site CA-SBA-537/1816. The site is partially within SLC-4W, described as follows.

On 15 May 2014, all previously un-surveyed areas were examined within the launch complex (Lebow 2014). That effort included a systematic walk-over by a team of two archaeologists spaced 15 m apart. One isolated artifact (designated VAFBISO-962) was identified in an area that had previously been disturbed and thus the artifact is considered to be out of context and was probably transferred there from another location. No previously unknown archaeological sites were identified during the survey.

Five archaeological sites and two isolated artifacts are recorded within 0.25 mi. (0.4 km) of SLC-4W. These include CA-SBA-537, -1127, -1815, -1816, -2427, VAFB-ISO-300, and VAFB-ISO-962. The latter was recorded within SLC-4W during the survey noted above. Of those, only CA-SBA-537 and VAFB-ISO-962 are within or partially within SLC-4W. CA-SBA-1816, while recorded as a separate site, is within CASBA-537 and forms a complex designated as CA-SBA-537/1816. Less than half of the site complex is within SLC-4W.

Construction of SLC-4 began in 1961. Initially, the two launch pads (SLC-4E and SLC-4W) were designed to launch Atlas/Agena vehicles. The first launch occurred on 12 July 1963. Over time, the pads were modified to accommodate various Titan launch vehicles. SLC-4 has played an important role in the U.S. military space program, with many launches of classified reconnaissance satellite systems (Nowlan et al. 1996). Due to their pivotal role during the Cold War, both SLC-4E and SLC-4W were recommended eligible for the National Register of Historic Places (NRHP) under Cold War Criterion A (Nowlan et al. 1996). However, VAFB, in consultation with the SHPO, subsequently determined that SLC-4 was not eligible for the NRHP.

3.6 Geology and Earth Resources

The ROI for Geology and Earth Resources is the SLC-4W construction area where ground-disturbing activities would take place. VAFB is located in a geologically complex area in the transition zone between the Southern Coast Range and Western Transverse Range Geomorphic Provinces. Marine sedimentary rocks of the Late Mesozoic age (140 to 70 million years Before Present [BP]) and Cenozoic age (70 million years BP to the present) underlie VAFB (Dibblee 1950). The dominant soil types on VAFB are (Shipman 1981)

- The Tangair-Narlon association, characterized by sands and loamy sands;
- The Marina-Oceano association, made up of sands;
- The Chamise-Arnold-Crow Hill association, characterized by sand to clay loams;
- The Concepcion-Botella association, characterized by loamy sands, fine sandy loams, and silty clay loams;
- The Sorrento-Mocho Camarillo association, characterized by sandy loams to silty clay loams;
- The Shedd-Santa Lucia-Diablo association, characterized by shaley clay loams accompanied by silty clays; and

- The Los Osos-San Andreas-Tierra association, which ranges from fine sandy loams to sandy loams with clay loams.

The predominant soil type (approximately 70 percent of SLC-4W) found at the proposed project site is the Oceano Sand, with 2 to 15 percent slopes. Oceano Sand is characterized by excessive drainage and a slight to moderate erosion hazard under normal climatic conditions. This soil type has a high infiltration rate with a low runoff potential. The Marina Sand soil type is found on the southern part of SLC-4W and is not in the direct area of the proposed landing pad.

VAFB is in Seismic Hazard Zone 4, as defined by the Uniform Building Code, which is the most severe seismic region and is characterized by areas likely to experience earthquakes of a magnitude of 7 or higher on the Modified Mercalli Scale and to consequently sustain major damage from earthquakes.

Numerous onshore and offshore faults have been mapped in the vicinity of VAFB; most are inactive and incapable of surface fault rupture or are unlikely to generate earthquakes. Four major faults have been mapped on VAFB: the Lion's Head fault on north VAFB and the Hosgri, Santa Ynez River, and Honda Faults on south VAFB. Other geologic hazards at VAFB are the potential for surface erosion, landslides, seacliff retreat, streambank erosion, tsunamis, and liquefaction.

No faults are located on or near the project site.

3.7 Human Health and Safety

3.7.1 Region of Influence

The ROI for Human Health and Safety resources includes all areas where activities associated with the Proposed Action may impact human health and safety. This includes the construction area at SLC-4W and all areas potentially impacted during boost-back and landing operations. All activities on VAFB are subject to the requirements of the federal OSHA, AFOSH and Cal/OSHA regulations and procedures.

The affected environment for Human Health and Safety includes all established regulations to minimize or eliminate potential risk to the general public and personnel involved in the proposed project. The Proposed Action would involve construction activities where workers would potentially be exposed to conditions that could adversely impact their health and safety. The ROI of these potential impacts is the Proposed Action area and surrounding vicinity.

Hazards associated with some past and present mission activities and operations on VAFB can constrain locations where projects can be sited to ensure the health and safety of workers. The following hazard zones have been established on VAFB to protect workers from various hazards:

- **Toxic hazard zones** are areas established downwind of launch site operations to protect workers from exposure to toxic vapors emitted during the transfer or loading of liquid propellants or maintenance of launch systems. These zones can extend 20,000 ft. (6,096 m) or more from a launch site.

- **Missile/Space Launch Vehicle Flight Hazard Zones and Explosive Safety Zones** are established under the flight path of missile or space launch vehicle launches to protect personnel from debris fall-out under the launch trajectory. Explosive safety zones are established from 75 to 5,000 ft. (22.9 to 1,524 m) around launch sites and buildings where rocket propellants are stored to protect personnel from potential explosive hazards. Both of these hazard zones must be evacuated before any launch.
- **Radiofrequency Radiation Hazard Areas** are established around transmitters on VAFB that can present radiation hazards to people and potentially detonate electro-explosive devices. The size of the hazard areas vary, depending on the transmitter power and antenna reception.
- **Airfield Clear Zones, Lateral Clear Zones (LCZs), and Accident Potential Zones (APZs)** are established around the VAFB airfield runway and contain restrictions on certain land uses. Clear zones and LCZs are areas where the accident potential is so high that land use restrictions prohibit reasonable use of the land. Clear zones occur at both ends of the runway, and LCZs extend 1,000 ft. (304.8 m) from both sides of the centerline along the length of the runway. The ground surface within the LCZ must be graded to certain requirements and kept clear of fixed or mobile objects, except for necessary navigational aids and meteorological equipment. There are two APZs, APZs I and II, which are less critical than clear zones but still possess significant potential for accidents. Acceptable uses within APZ I areas include industrial or manufacturing, communication and utilities transportation, wholesale trade, open space, recreation, and agriculture, but not uses that concentrate people in small areas. Acceptable uses within APZ II areas include low business services and commercial retail trade uses of low intensity or scale of operation, but not high density operations.
- **Air Installation Compatible Use Zones (AICUZs)** are areas where certain land uses are restricted due to the combination of the potential for accidents and noise and the need for clearance of obstacles.
- **Unexploded Ordnance Closure Areas** are areas on VAFB that were used as ordnance training ranges and have the potential to contain UXO. On 27 September 2010, all areas known or suspected to contain UXO on VAFB were closed to non-mission/recreational activities. Any proposed work in these areas must be coordinated with the Weapons Safety and Explosive Ordnance Disposal (EOD) offices. Depending on the area, escorts may or may not be required.

3.7.2 Construction Activities

Industrial hygiene and ground safety during SLC-4W modifications and boost-back landing operations would be the responsibility of SpaceX and/or its contractor(s) safety department. Industrial hygiene responsibilities include monitoring and exposure to workplace chemicals, radiation, physical hazards, hearing and respiratory protection, medical monitoring of workers subject to chemical exposures, and oversight of all hazardous or potentially hazardous operations. Ground safety responsibilities include protection from hazardous situations and hazardous materials.

Because of conditions described in detail in Section 3.8 (Hazardous Materials and Waste Management), the potential exists for persons participating in the construction and grading activities to become exposed to hazardous materials and hazardous waste. In addition to those hazards, other physical hazards (e.g., confined spaces, uneven terrain, holes, and ditches) and biological hazards (e.g., rattlesnakes, ticks, black widow spiders, and poison oak) occur at the project site.

3.7.3 General Public and On-Base Personnel Safety

The 30 SW Safety Office has the responsibility to ensure the safety of launch support personnel and the general public from all launch and landing operations as defined in AFSPCI 91-217 (Space Safety and Mishap Prevention Program). Safety would assess proposed mission profiles (landing at SLC 4W and off-shore contingency) to ensure public safety criteria are met. The evaluation would assess hazards associated with debris, toxics, and blast distant focusing overpressure for a normal launch and landing failure. All launch area, high-risk offshore, and airspace would be controlled and monitored to ensure public safety during launch and landing operations. In addition, launch day meteorological conditions would be accounted for in day of launch and landing risk analysis to ensure compliance with acceptable risk criteria.

3.7.3.1 Debris Impact Corridors

All launch and landing programs at VAFB are required to establish debris impact corridors as a part of their program's safety review, in case of a launch or landing anomaly that requires flight termination. When any launch and landing, including a commercial launch, is scheduled to take place from VAFB, the 30th Space Wing Launch Safety (30 SW/SEL) notifies the 2nd Range Operations Squadron (2 ROPS) of the associated hazard areas. SpaceX would accomplish a debris analysis, for the boost-back and landing program and would accomplish an analysis prior to its first landing. 30 SW/SEL would review and approve these analyses prior to authorizing any activities. Impact debris corridors would be established off the Santa Barbara County coast between Point Sal and Point Conception to meet security requirements and reduce hazards to persons and property during landing related activities. Specific debris impact areas would be determined for each landing, based on its specific trajectory. Once notified of hazard areas by the 30 SW/SEL, the 2 ROPS notifies the FAA so that appropriate airspace restrictions are in place during launches and landings. The U.S. Coast Guard issues a Local Notice to Mariners prior to launches from VAFB that defines the times and locations of Public Ship Avoidance Areas related to launch activities. Local Notice to Mariners are broadcast via radio and posted in harbors along the coast, as well as being published in the weekly U.S. Coast Guard Long Beach Broadcast to Mariners.

Offshore oil rigs located west of 120 degrees 15 minutes longitude also have evacuation or shelter-in-place procedures in place for use during launch and landing operations. The 2 ROPS notifies the Minerals Management Service to notify oil rig personnel of launch and landing operations.

Some local beaches, including Ocean Beach and Jalama Beach county parks, also fall within some debris impact corridors necessitating their closures during launch and landing operations.

Although the beaches are not directly over flown by the First Stage during boost-back, an anomaly could impact them. Therefore, for the safety of park visitors, the County Parks Department and the County Sheriff close the parks upon request from VAFB.

A Union Pacific railroad line runs through VAFB. On south VAFB, the track passes between the Pacific Ocean and the launch facilities, and are over flown during launches and landings. Railroad schedules and close coordination between train engineers and VAFB personnel, ensure that trains are never over flown, to reduce potential risk to people and property. To that end, 30 SW/SEL defines appropriate railroad mile markers to 2 ROPS, who coordinates with the Manager Road Operations to ensure trains are kept clear of the landing area.

The FireX system would be installed to control any fires ignited during landing. Visual observations from Mission control would alert of any flames or fire present at the landing pad, in which case the 30th Space Wing Civil Engineer Squadron, Fire Department would be notified and the water cannons would be activated.

3.7.4 Security and Anti-Terrorism

Site security requirements, including those for security lighting and intrusion detection, are part of the requirements integral to launch program safety. 30th Space Wing Instruction (30 SWI) 31-101, Air Force Instruction (AFI) 31-101, and DoD Manual 5220.22-M detail these security requirements. Unified Facilities Criteria 4-010-01 was issued in January 2007 under the authority of DoD Instruction 2000.16, Antiterrorism Standards. This guidance requires DoD components to adopt and adhere to common definitions, criteria, and minimum construction standards for building to mitigate vulnerabilities and terrorist threats. Modifications to SLC-4W made by SpaceX would be required to meet these construction standards.

3.7.5 Existing Noise Environment

For a detailed description of Noise see Section 3.2 (Sound [Airborne]). The NCA (42 U.S.C. 4901 et seq.) sought to limit the exposure and disturbance that individuals and communities experience from noise. It focuses on surface transportation and construction sources, particularly near airport environments. The NCA also specifies that performance standards for transportation equipment be established with the assistance of the DOT. Section 7 of the NCA regulates sonic booms and gave the FAA regulatory authority after consultation with the EPA. In 1987, the Quiet Community amendment gave state and local authorities greater involvement in controlling noise.

Existing noise levels on VAFB are generally quite low due to the large areas of undeveloped landscape and relatively sparse noise sources. Background noise levels are primarily driven by wind noise; however, louder noise levels can be found near industrial facilities and transportation routes. Rocket launches and aircraft overflights create louder intermittent noise levels. On VAFB, general ambient L_{eq1H} (the continuous sound level that would contain the same acoustical energy for 1 hour as the fluctuating sound levels during the same period) measurements have been found to range from around 35 to 57 dB (Berg et al. 2002). Most activities associated with the Proposed Action would generate relatively continuous noise throughout the implementation period.

3.8 Hazardous Materials and Waste Management

3.8.1 Region of Influence

The ROI for Hazardous Materials and Waste Management resources includes all areas where activities associated with the Proposed Action may be impacted by the use of hazardous materials and the generation of hazardous waste. This includes the construction area at SLC-4W, all areas potentially impacted during boost-back and landing operations, and operations and activities associated with the recovery of the First Stage for reuse.

Hazardous materials and wastes are those substances defined as hazardous by the Comprehensive Environmental Response, Compensation, and Liability Act, as amended by the Superfund Amendments and Reauthorization Act (42 U.S.C. 9601-9675); the Toxic Substances Control Act (15 U.S.C. 2601-2671); the Solid Waste Disposal Act, as amended by the Resource Conservation and Recovery Act (Resource Conservation and Recovery Act; 42 U.S.C. 6901-6992); and as defined in the State of California corresponding laws and regulations. SpaceX would use an existing 90-day hazardous waste accumulation point located at SLC-4W for hazardous materials and waste management. In addition, federal and state OSHA regulations govern protection of personnel in the workplace. In general, the definitions within the citations include substances that, because of their quantity, concentration, or physical, chemical, or infectious characteristics, may present substantial danger to public health and welfare, to workers, or to the environment.

3.8.2 Hazardous Materials at VAFB

Operations at VAFB and associated properties require the use of hazardous materials by military personnel and on-base contractors in varying quantities throughout the base.

Hazardous material use on VAFB is regulated by AFI 32-7086, Hazardous Materials Management Plan, and emergency response procedures for hazardous materials spills are established in VAFB's Hazardous Materials Emergency Response Plan (U.S. Air Force 2010a). SpaceX would be responsible for preparing its own Emergency Response Plan for boost-back program per the VAFB Hazardous Materials Emergency Response Plan. This Plan would ensure that adequate and appropriate guidance, policies, and protocols regarding hazardous material incidents and associated emergency response are available to and followed by all installation personnel and commercial entities. In the event of a spill, SpaceX would also be responsible for completing a Community Awareness and Emergency Response reporting form per local Santa Barbara County hazardous material and hazardous waste spill reporting requirements.

3.8.3 Hazardous Waste at VAFB

Hazardous waste regulations are implemented at VAFB through hazardous waste handling procedures outlined in AFI 32-7042, Waste Management, and the VAFB Hazardous Waste Management Plan (U.S. Air Force 2011b). The plan details hazardous waste packaging, turn-in, transportation, storage, recordkeeping, and emergency procedures. SpaceX would be required to follow all federal, state, and local laws and regulations regulating the generation, storage, transportation, and disposal of hazardous waste.

3.8.3.1 Hazardous Materials Transportation Safety

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

3.8.4 Toxic Release Contingency Plans and Toxic Hazard Corridors

Toxic hazard assessments would be required for the Falcon 9 and Falcon 9 Heavy programs to determine program-specific toxic material used for launches, payloads, GSE, and at facilities. 30 SW has detailed procedures in place to control use of toxic gases. VAFB maintains 30 SWI 91-106, Toxic Hazard Assessments, which defines control measures and procedures for conducting operations involving toxic fuels. Atmospheric and dispersion computer models are run by 30 SW/SE to predict toxic hazard corridors (THCs) for nominal and aborted launches, as well as for spills or releases of toxic materials from storage tanks or that occur during loading or unloading of propellants. 2 ROPS uses THCs to reduce the risk of exposure of launch personnel and the general public from toxic materials, including toxic gases. Dispersion modeling for the Falcon 9 and Falcon 9 Heavy programs would be run for nominal and abort scenarios prior to each launch. If the model predicts THCs over populated areas, the launch would be delayed until meteorological conditions allowed for launch to occur without this risk.

3.8.4.1 Exposure Criteria

The USAF Surgeon General (HQ AF/SG) has, through AFMAN 48-155, Occupational and Environmental Health Exposure Controls, granted local authority to determine the Occupational and Environmental Exposure Limit (OEEL). The OEEL is defined as, "…the most appropriate limit adopted from established recognized standards including, but not limited to, those in AFIs and AFOSH Standards, the latest edition of the TLV® Booklet published annually by the American Conference of Government Industrial Hygienists; 29 C.F.R. 1910.1000 Tables Z-1, Z-2, and Z-3; and 40 C.F.R. 141…" Bioenvironmental Engineering at the 30th Medical Group would determine the OEEL for chemicals estimated to pose the most significant health concerns to the public and launch facility workers. The exposure criteria are factored into the exposure prediction and risk management models, and the launch commit decisions used by 30 SW/SE at VAFB.

3.8.5 Environmental Restoration Program at VAFB

The Environmental Restoration Program (ERP), formerly known as the Installation Restoration Program (IRP), was developed by the DoD in 1984 to identify, investigate, and remediate potentially hazardous material disposal sites on DoD property. Once the areas and constituents had been identified, the ERP was tasked to remove or monitor the hazards in an environmentally responsible manner. The only IRP requirement within the Project Area is to protect all Monitoring Wells within the area.

The installation also manages MMRP sites. The MMRP was established to address UXO, discarded military munitions (DMM), and munitions constituents (MC) located on current and former defense sites (U.S. Army Environmental Center 2009). These sites are separate from operational ranges or munitions storage facilities.

In addition to ERP and MMRP sites, the installation also identifies those areas that have had known or suspected contamination from Underground Storage Tanks.

Previous launch operations at SLC-4W resulted in the release of hazardous materials to the environment during maintenance and operations. SLC-4W is located within ERP Site 9, which is part of a larger ERP Site 8 cluster (Figure 3-15). The ERP Site 8 cluster consists of Sites 8 (SLC-4E), 9 (SLC-4W), and 10 (Spring Canyon). These sites have been grouped together due to their similar operational and contaminant release history. The contaminants of concern (COCs) include VOCs and perchlorate in groundwater, and metals, polycyclic aromatic hydrocarbons (PAHs), and polychlorinated biphenyls (PCBs) in subsurface soil.

Trichloroethylene (TCE) and perchlorate released at the site during launch motor flushing and from solid fuel rocket booster motors have been identified as the source of groundwater contamination. Sandblast grit blown by wind or spread for disposal during operations in areas located west, and southeast of the launch pad are the source of metals, PAHs and PCBs in soils.

Remedial actions for groundwater contamination has included source reduction using a dual-phase extraction (DPE) system that was comprised of twenty-three vertical extraction wells. In 2009, additional treatment wells were installed within the deluge channel. The deluge channel is the flame duct that runs directly south from the old Titan II launch mount and would be adjacent to the landing pad.

Previous remedial actions for soil at SLC-4W have removed PCBs, PAHs, and metals from soils to levels below clean-up goals for the site. Actions included removing sandblast grit from three areas at the Site to remediate metals, PAHs and PCBs in surface soil (U.S. Air Force 2010b). The primary objective of the excavation activities at ERP Site 9 was to remove soil impacted with PCBs, PAHs, lead, and zinc that exceeded the cleanup goals established for the site. However, the areas beneath the concrete foundations of the launch pad and flame duct were not remediated at that time. Remedial activities at Site 8 cluster are ongoing and are specified in the Final Record of Decision/Remedial Action Plan, Installation Restoration Program Site 8 Cluster (U.S. Air Force 2013a).

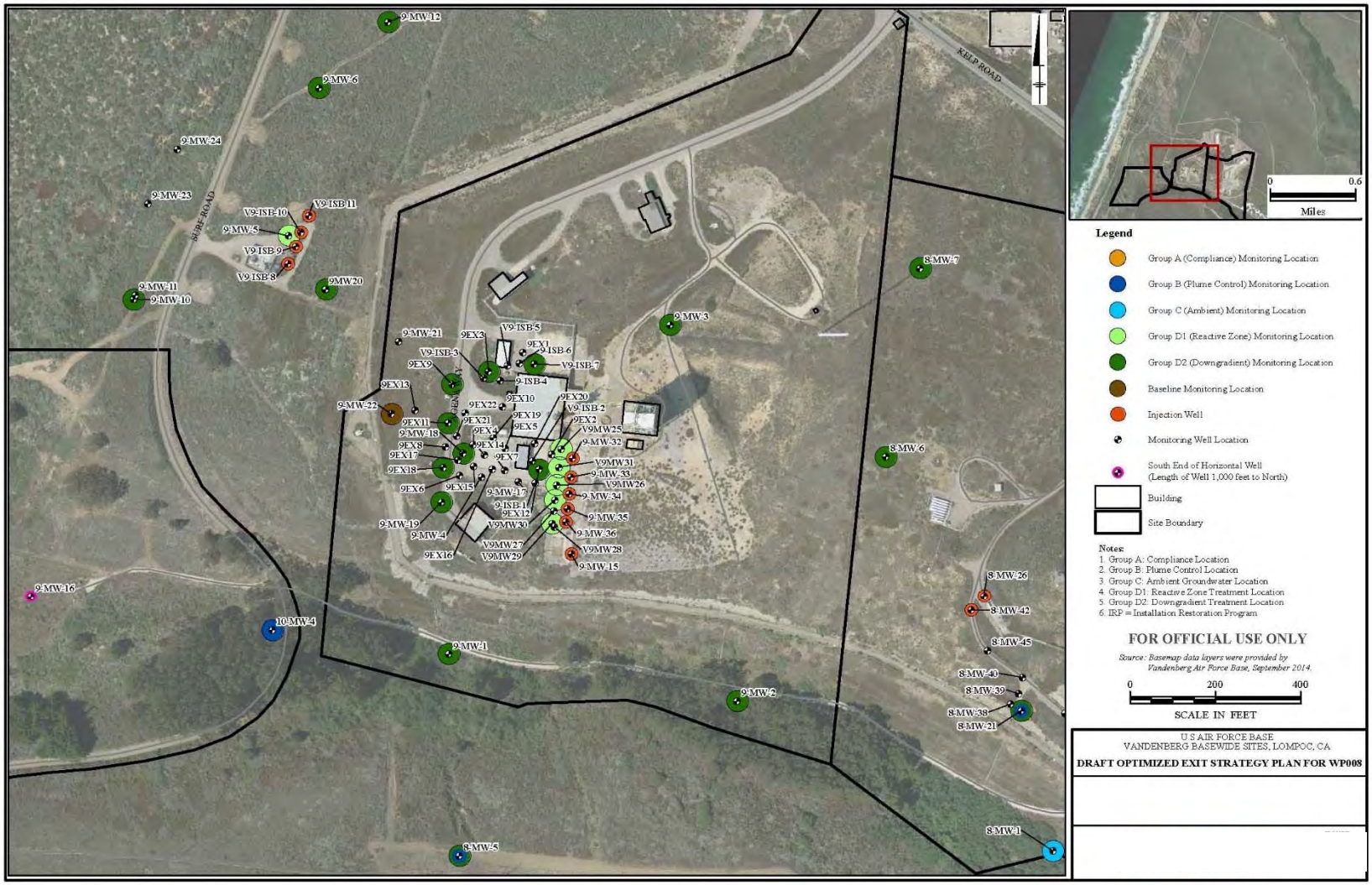


Figure 3-15. ERP Sites at SLC-4W

3.8.6 Military Munitions Response Program

The project site straddles the boundary of former artillery impact area MU816 and Training and Maneuver Area TM817B; each formerly used by the U.S. Army before USAF acquisition of the site (Shaw Environmental, Inc. 2006). According to data provided in the CSE Final Phase II Report (Shaw Environmental, Inc. 2010) and After Action Report (U.S. Army Corps of Engineers 2013), the surrounding areas of the project site were searched for munitions and explosives of concern (MEC) and munitions debris (MD) associated with historic range use. MEC and MD were found on the south portion of VAFB near the project site (Shaw Environmental, Inc. 2010; U.S. Army Corps of Engineers 2013).

3.9 Solid Waste Management

The affected environment for Solid Waste Management is the regulatory environment for solid waste management issues established to control construction debris and promote pollution prevention involved with the Proposed Action. The ROI of potential impacts to Solid Waste Management as a result of the Proposed Action encompasses VAFB, which may be impacted by increased solid waste generation during construction of the landing pad at SLC-4W. In addition, waste generated by the recovery of the Falcon 9 Full Thrust First Stage would impact VAFB diversion and solid waste metrics. In 1989, the California Integrated Waste Management Act (AB 939) mandated a 50 percent reduction of the quantity of solid waste disposed of in California landfills from a 1990 baseline. The 50 percent reduction was to be accomplished by 1 January 2000. The most recent USAF mandate regarding solid waste diversion came from Headquarters Air Force Space Command (AFSPC) in 2008, requiring a 50 percent diversion rate goal for all solid waste generated at AFSPC installations (AFI 32-7042).

The State of California passed Senate Bill 1374, amending the Public Resources Code, Section 42912, which addresses the issue of construction and demolition (C&D) debris, diversion requirements, and the development of a model ordinance to be implemented by local jurisdictions (e.g., Santa Barbara County). EO 13514, "Federal Leadership in Environmental, Energy, and Economic Performance," was signed on 5 October 2009. With respect to solid waste diversion, EO 13514 requires federal agencies to have as a goal to achieve 50 percent or higher diversion rate for Non-hazardous solid waste and construction and demolition materials and debris by fiscal year 2015. In August 2010, the DoD issued its updated Strategic Sustainability and Performance Plan (SSPP), which was followed up by Headquarters Air Force releasing its SSPP Implementation Plan in October 2011. The established diversion goals of the SSPP are 60 percent diversion, by weight, for C&D debris by 2015. AFI 32-7042 requires installations to strive to divert as much solid waste as economically feasible and the VAFB Integrated Solid Waste Management Guide (U.S. Air Force 2012a) requires source segregation of recyclable materials to the greatest extent possible.

In addition, on 1 March 2004, the California Integrated Waste Management Board promulgated a model ordinance for local agencies to follow for implementing a 50 to 75 percent diversion of C&D waste from landfills, per California Senate Bill 1374. Currently, the local enforcement agency, the Santa Barbara County Environmental Health Services Division, has not promulgated its final model ordinance.

However, a locally adopted diversion ordinance would affect requirements because the Federal Facilities Compliance Act waived sovereign immunity with respect to California solid waste programs. Since 1998, waste diversion at VAFB has been greater than 70 percent (U.S. Air Force 2012a). Due to the detailed tracking requirements for waste disposal and diversion levied by the State of California, VAFB is required to track all materials going off-base for diversion, recycling, or disposal. VAFB must report the weight (in tons), the type of material, and the destination. Additionally, any materials recycled on-base by processes other than the base landfill must be reported to the 30 CES/CEI Solid Waste Manager at least quarterly, with copies of weight tickets and receipts provided. SpaceX would transport solid waste to the Santa Maria Landfill for disposal. The party/unit responsible for the diversion, disposal, or recycling reports the information to the Solid Waste Manager.

3.9.1 Construction Debris

There are different processes established for handling and disposing of construction debris. Debris from new construction is typically uncontaminated and is reused or recycled whenever feasible. Material segregation and storage are also less of a problem with new construction than with demolition. Cost differentials between tipping fees and costs associated with reuse and recycling also influence disposal decisions.

3.9.2 Pollution Prevention

The Pollution Prevention Act (PPA) of 1990 focused the national approach to environmental protection toward pollution prevention (P2). Implementation of the USAF Environmental Management System (EMS) carries P2 a step further toward mission sustainability principles. The P2 program is defined in detail in the VAFB Pollution Prevention Management Plan, 30 SW Plan 32-7001 and is aimed at achieving 30 SW EMS objectives and targets, through documented practices, procedures, and operational requirements. VAFB implements EMS and its associated P2 program elements by following the P2 hierarchy:

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

3.10 Land Use and Aesthetics

The affected environment for Land Use and Aesthetics is the regulatory environment for land use planning and aesthetics on VAFB. The ROI for land use purposes in this EA encompasses the landing pad construction area at SLC-4W (Figures 2-1 and 3-16) and south VAFB. The construction area is located on South Base, approximately 0.5 mi. (0.8 km) inland from the Pacific Ocean (Figures 1-1 and 1-2).

VAFB covers approximately 99,099 ac. (0.40 km^2) in western Santa Barbara County and is divided into North VAFB and South VAFB by the Santa Ynez River and Highway 246, a public thoroughfare. Much of VAFB is open space set aside for security and safety buffer zones. VAFB accommodates agricultural outleasing as a major land use on base.

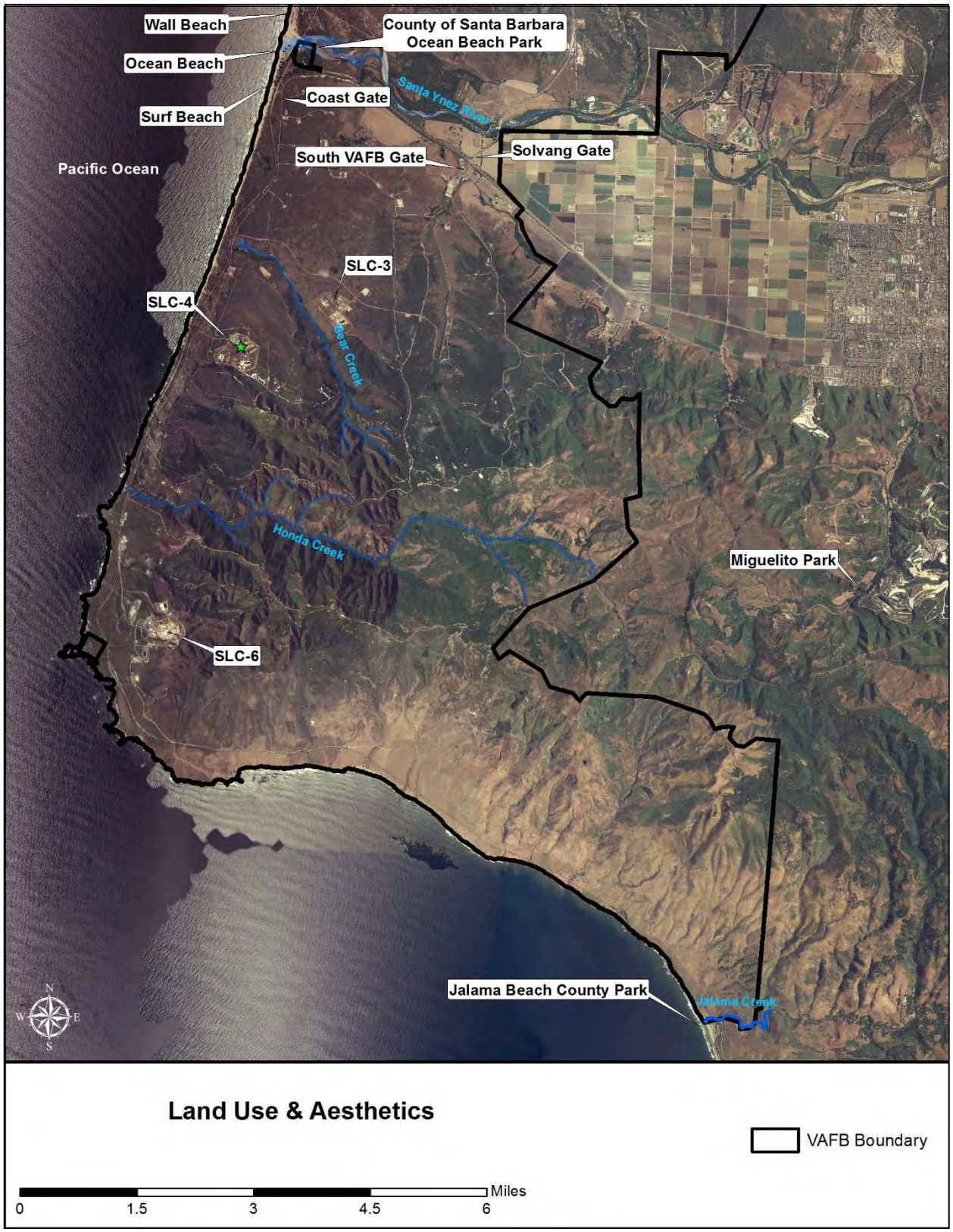


Figure 3-16. Land Use and Aesthetics around SLC-4W on VAFB

At present, 23,500 ac. (0.09 km^2) of rangeland are permitted for grazing activities, supporting a maximum of 800 head of cattle, and 1,104 ac. (0.004 km^2) are dryland farmed. All grazing land and farmland at VAFB is used by the U.S. Department of Justice, Bureau of Prisons, and U.S. Penitentiary in Lompoc for livestock grazing and 1,104 ac. (0.004 km^2) for dryland farming.

Facilities used for space launches, missile tests, and telemetry and tracking are scattered throughout the base. The urbanized cantonment area is on North VAFB, which includes various administrative, training, industrial, commercial, and residential land uses. North VAFB also has missile test launch sites, space launch sites, and tracking facilities. South VAFB supports space launch sites, telemetry, and tracking facilities. All of these facilities support the primary mission of VAFB. The 30th Civil Engineering Squadron, Comprehensive Planning (30 CES/CEIOP) manage development and land use at VAFB. The primary document that outlines development goals and constraints is the VAFB General Plan (U.S. Air Force 2014a). Land use areas on both North and South VAFB include recreational use of beaches by the military. In addition, there is public access to Surf Beach. Immediately east of these recreational beach areas is open land set aside for security and safety buffer zones.

A Union Pacific railroad line passes through VAFB near the coast. It serves as the main line for Los Angeles to San Francisco coastal rail transportation, providing freight service to most cities along the coast. A number of spur lines operate off the main line in the VAFB area to provide local freight delivery. Amtrak passenger service from Seattle to San Diego, share these Union Pacific Railroad lines (U.S. Air Force 1988). The Surf Amtrak Station is located adjacent to Surf Beach, at the west end of SR 246.

The existing site is surrounded by open space with Industrial land use designated approximately 2 mi. (3.2 km) south, and 1 mi. (1.6 km) north of SLC-4W. Dryland farming and cattle grazing occurs to the north, east and west of 13th Street and south of Terra Road, which are approximately 1.5 mi. (2.4 km) northeast of SLC-4W. Dryland farming continues to the south of the 13th Street Bridge, east and west of 13th Street and north of West Ocean Avenue (State Route 246). Wildlife viewing areas are located at the Waterfowl Natural Resources Area south of Terra Road and west of 13th Street, approximately 5 mi. (8.1 km) northeast of SLC-4W. The County of Santa Barbara Ocean Beach Park is located immediately west of the Wetland Mitigation Area, approximately 4 mi. (6.4 km) north of SLC-4W, where there is wildlife viewing, beach access, and a picnic area (Figure 3-16).

3.10.1 Land Use

Under the 2014 General Plan for VAFB, which is the primary comprehensive planning document for the installation, there are 12 land use designations on Base. They are Administrative, Air Education and Training Command, Agriculture/Grazing, Airfield, Community (Commercial and Service), Housing, Industrial, Launch Operations, Medical, Open Space, Outdoor Recreation, and Water/Coastal (U.S. Air Force 2014a). SLC-4W is in an area designated for Launch Operations.

3.10.2 Aesthetics

NEPA Section 101 states that, “the Nation may assure for all Americans, safe, healthful, productive, and aesthetically and culturally pleasing surroundings,” (42 U.S.C. §§4321-4370h). As

such, aesthetics of the Proposed Action must be taken into consideration. CZMA also has a policy that protects the scenic beauty of the coastal landscape. Although VAFB is excluded from the coastal zone as it is land wholly owned and operated by the Department of Defense, the USAF is required to maintain consistency with CZMA. The site of the Proposed Action, SLC-4W, is located within the California Coastal Zone. The SLC-4W launch complex is visible from Coast road because of its Mobile Service Tower. SLC-4W is not visible however, from any public beach, and is only momentarily visible from a passing train (U.S. Air Force 1991). See Section 3.11 (Coastal Zone Management), for additional discussion.

3.11 Coastal Zone Management

Federal activity in, or affecting, a coastal zone requires preparation of a Coastal Zone Consistency Determination (CD) or an ND, per the CZMA. The ROI for Coastal Zone Management includes the landing pad construction area at SLC-4W (Figure 2-1) and Coastal Zone resources in the Pacific Ocean, including marine mammals and marine mammal habitats, that may be affected by the Proposed Action.

The California Coastal Zone Management Program was formed through the California Coastal Act (CCA) of 1972, the federal law that protects the nation's coastlines. "Coastal zone" is defined in Section 304 of the CZMA and does not include "lands the use of which is by law subject solely to the discretion of or which is held in trust by the Federal government." The Proposed Action occurring at VAFB is wholly owned and operated by the Department of Defense and is therefore excluded from the coastal zone. However, the USAF is required to maintain consistency with the CZMA and is responsible for making final coastal zone determinations for its activities occurring within the state coastal zone or having effects on it. Although the Proposed Action does not occur within the Coastal Zone, it may potentially affect resources within the Coastal Zone, therefore a CD or ND is required for the Proposed Action. The CCC reviews federally authorized projects for consistency with the California Coastal Zone Management Program, and either concurs with a ND finding or does not.

Applicable CCA policies include:

- Providing for maximum public access to the coast;
- Protecting marine and land resources, including environmentally sensitive habitat areas, such as wetlands, riparian corridors and creeks, rare and endangered species habitat, and marine habitat, such as tide pools;
- Protecting the scenic beauty of the coastal landscape;
- Maintaining productive coastal agricultural lands;
- Recreational boating use; and
- Oil and hazardous substance spill prevention, preparedness and response in the marine environment.

3.12 Transportation

The ROI for Transportation resources are the existing access roadways to SLC-4W, including Coast Road, Hwy 101, Hwy 1, SR 1, SR 135, and SR 246 (Figures 1-1, 1-2, and 3-17). Existing roadway conditions are evaluated based on roadway capacity and traffic volume. The capacity, which reflects the ability of the network to serve the traffic demand of a roadway, depends on the roadway width, number of lanes, intersection control, and other physical factors. Traffic volumes can be reported as the number of vehicles averaged over a daily period (average daily traffic or ADT).

A road's ability to accommodate different volumes of traffic is generally expressed in terms of Level of Service (LOS). The Institute of Transportation Engineers (1982) defines LOS as "a qualitative measure that incorporates the collective factors of speed, travel time, traffic interruptions, freedom to maneuver, safety, driving comfort, and convenience, and operating costs provided by a highway facility under a particular condition." The LOS scale ranges from A to F, with each level defined by a range of traffic volume to roadway capacity (V/C). LOS A represents the best operating conditions, while a LOS F represents the worst (Table 3-8).

Table 3-8. Level of Service Scale

LOS Level	Condition
A	Traffic flows at or above the posted speed limit and all motorists have complete mobility between lanes.
B	Traffic slightly more congested than LOS A, but speed remains the same. Some restrictions to maneuverability; motorists may drive side by side limiting lane changes.
C	More congestion than LOS B. Ability to pass or change lanes not always assured. Target for most urban highways and most rural highways. Roads are efficiently close to capacity, and posted speed is maintained.
D	Speeds are somewhat reduced, motorists are restricted by other cars and trucks. Equivalent to a functional urban highway during commuting hours. Common goal for urban streets during peak hours.
E	Flow becomes irregular and speed varies rapidly without reaching posted limits. Consistent with a road at or approaching its designated capacity.
F	Lowest measure of efficiency. Flow is forced, with all vehicles restricted by those in front; frequent slowing required. This is a road in constant traffic jam.

Note: LOS = Level of Service

3.12.1 Regional Access

VAFB is located approximately 5 mi. (8.1 km) west of the City of Lompoc. The main access route to VAFB is Hwy 101 (Figure 1-1). Highway 101 is a coastal four-lane divided freeway connecting northern California to southern California.

The VAFB connections to Hwy 101 are Hwy 1, SR 135, and SR 246. Highway 1, a north-south highway, traverses VAFB and provides access to Santa Maria to the northeast, and Santa Barbara to the southeast (Figure 1-2). When used in conjunction with Hwy 101, SR 246, an east-west highway, provides access to Lompoc to the east, and Santa Barbara to the southeast. SR 135 and SR 246 are mostly two-lane undivided highways with four-lane rural expressway portions. SR 246 is accessible from the south through Hwy 1 and Hwy 101.

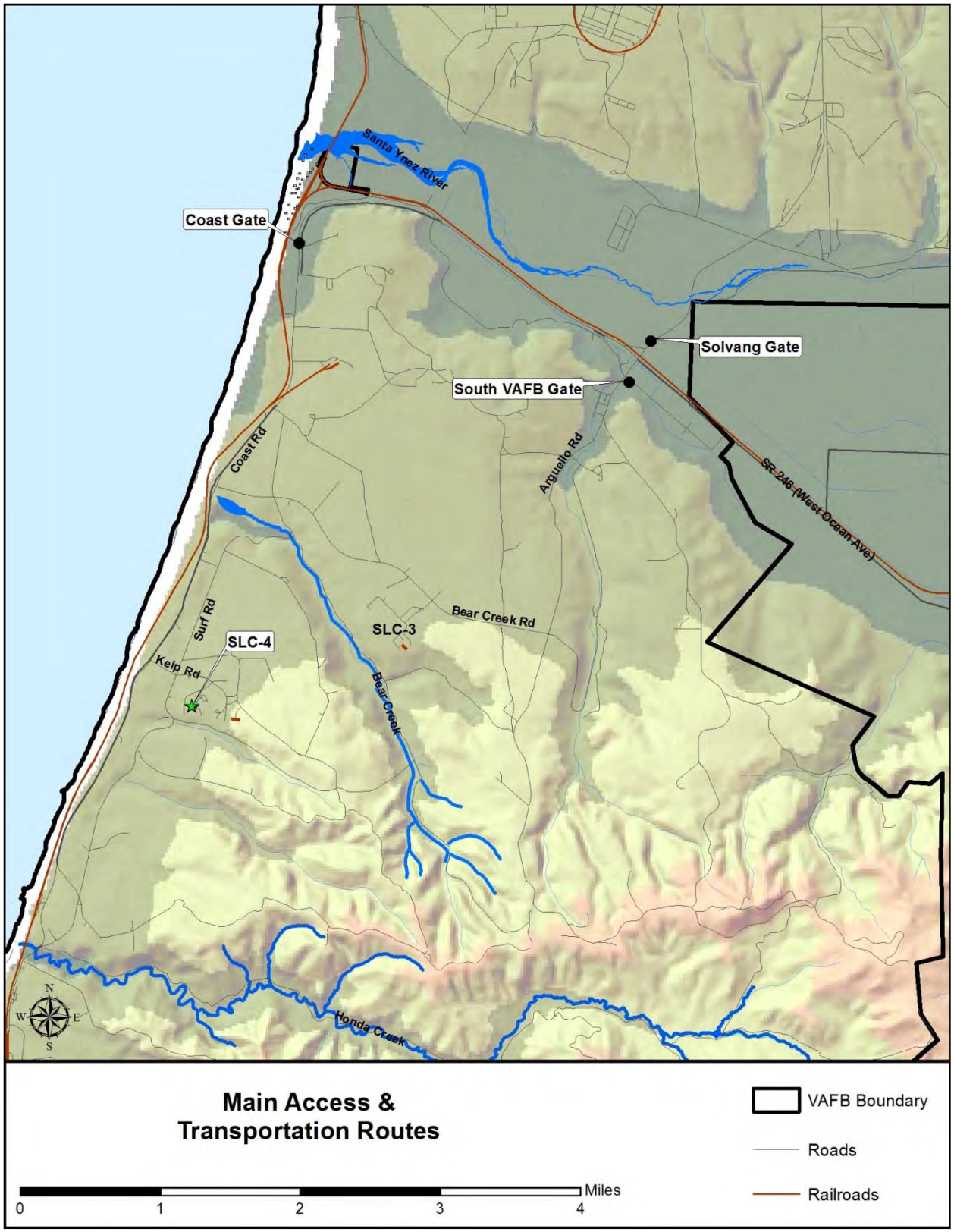


Figure 3-17. Main Access and Transportation Routes Associated with the Proposed Action

SR 246 services the South Base Gate, the primary access for south VAFB. Further west, at the terminus of SR 246, is the Coast Gate, which is normally closed, but is occasionally opened for oversized shipments to south VAFB. SLC-4W lies within the entry-controlled area of south VAFB. Only authorized military personnel and their families, civilian employees of Base with approved identification, and visitors with pre-approved authorization, can enter the entry- controlled area.

On VAFB, roads are categorized as highways, primary, local (secondary roads), and patrol (U.S. Air Force 2014b). Primary roads serve large volumes of traffic, are divided, and provide limited access to adjacent land uses. They act as the main circulation routes into and through the cantonment areas and connect to local streets (U.S. Air Force 2014a). Local streets provide for traffic movement between primary roads and access roads and provide access to community facilities, parking lots, and housing and service areas. They make up the majority of the road network in the cantonment area and have frequent traffic stops and low speeds (U.S. Air Force 2014a). Patrol roads are remote roads that are paved or unpaved and are used for security patrol and monitoring of infrastructure (U.S. Air Force 2014a). On South Base the primary roads include Arguello Road, Bear Creek Road and Coast Road (U.S. Air Force 1994a), all of which could be used to access SLC-4W (Figure 3-17). All primary roads on VAFB operate at a LOS between A and C (U.S. Air Force 1994b). Local (secondary) roads operate at a LOS between A and B (U.S. Air Force 1994b). Informal traffic studies indicate gates operate at LOS A to C range (U.S. Air Force 2005a).

3.13 Department of Transportation Act Section 4(f) Properties

The ROI for Department of Transportation Act Section 4(f) Properties includes public parks and recreation areas are located near SLC-4W (Figures 1-1 and 3-16), described below. The FAA is subject to Section 4(f) of the Department of Transportation Act (49 U.S.C. Section 303(c)) as a non-exempt Department of Transportation agency. Section 4(f) properties include publicly owned parks, recreation areas, and wildlife or waterfowl refuges, or any publicly or privately owned historic site listed or eligible for listing in the NRHP. Per FAA Order 1050.1F, *Environmental Impacts: Policies and Procedures*, the FAA will not approve any program or project that requires the use of any Section 4(f) property determined by the officials having jurisdiction thereof, unless no feasible and prudent alternative exists to the use of such land and such program, and the project includes all possible planning to minimize harm resulting from the use.

The term use—as it relates to Section 4(f)—denotes an adverse impact to, or occupancy of, a Section 4(f) property. There are three conditions under which use occurs:

- Permanent Incorporation – when a Section 4(f) property is acquired outright for a transportation project.
- Temporary Occupancy – when there is temporary use of property that is adverse in terms of Section 4(f)'s preservationist purpose.
- Constructive Use – when the proximity impacts of a transportation project on a Section 4(f) property, even without acquisition of the property, are so great that the activities, features, and attributes of the property are substantially impaired. Substantial impairment would occur when impacts to Section 4(f) lands are sufficiently serious that

the value of the site in terms of its prior significance and enjoyment are substantially reduced or lost.

Public parks and recreation areas are located near SLC-4W and could be considered properties subject to Section 4(f). These include Jalama Beach County Park, Surf Beach, County of Santa Barbara Ocean Beach Park, Wall Beach, Miguelito Park, Rancho Guadalupe Dunes County Park, Point Sal Beach State Park, and Gaviota Beach State Park (Figures 1-1 and 3-16).

Jalama Beach, Surf Beach, and Ocean Beach County Parks are closest to SLC-4W. Jalama Beach County Park is a 23.5 ac. (0.1 km^2) park located south of SLC-4W. A popular camping spot, Jalama Beach maintains 98 campsites overlooking the ocean or beachfront with peak attendance over the summer and holiday weekends. In addition to camping facilities, Jalama Beach offers picnicking, surfing, whale watching, bird watching, nature photography, and fishing. Ocean Beach County Park is a 36 ac. (0.15 km^2) park located north of SLC-4W. It is a day-use only park, providing recreational opportunities such as bird watching, nature photography, and picnic facilities, from 8:00 a.m. to sunset.

3.14 Utilities

The ROI for utilities includes the SLC-4 complex and south VAFB utilities (i.e., communications, electricity, domestic water supply, and domestic wastewater). The affected environment for Utilities summarizes the utility systems available in the project area and its vicinity. SLC-4W is an above-ground launch pad with full utilities available. Existing utilities at the project site include electrical, communications, domestic water supply, and domestic wastewater. Due to SLC-4W being an active launch site as of 1999, it currently has all utilities required for the Proposed Action already installed to the site, including sewer, water, communication, electrical, and nitrogen (N_2). For most of these utilities, simple above-ground modifications are required to provide final routing of these utilities to their final destinations. These utilities at the project site would be extended from their current location to provide services (including a FireX system) to the proposed concrete landing pad at SLC-4W. SLC-4W has a packaged septic tank-leach system with a maximum design capacity of 15,000 gallons per day (U.S. Air Force 1991). New utility usage above what has previously been experienced at the project site or nearby would not occur under the Proposed Action.

3.14.1 Electrical

Existing electrical infrastructure around the SLC-4W area (existing conduits, camera stands, junction boxes) would be used to the greatest extent possible to reduce requirements for trenching.

3.14.2 Communications

There is an existing commercial fiber connection at SLC-4W. This existing commercial fiber connection would allow the USAF to avoid making a fiber connection at another location on VAFB to execute the Proposed Action.

3.14.3 Water

Existing underground water lines are sufficient in size to support the proposed FireX system at SLC-4W. A tie into the water system would be required and trenching for new water lines to connect to the FireX system is required.

3.14.4 Wastewater Treatment

The existing facilities at the pad building at SLC-4W, including a restroom and septic system, would be used for any additional wastewater inputs. The site would not be manned permanently and these facilities would be used when personnel are on site. Since the existing system has sufficient capacity to support the Proposed Action no additional wastewater inputs from the development and use of the landing pad at SLC-4W would be required. The site is not manned permanently, the existing facilities at the pad building (get number) would be used to support personnel present on site.

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4 Environmental Consequences

This chapter presents the results of the analysis of potential environmental effects of implementing Alternative 1, Alternative 2, and the No-Action Alternative as described in Chapter 2 (Description of the Proposed Action and Alternatives). For each environmental component, anticipated impacts are assessed considering short- and long-term effects.

4.1 Air Quality

Potential impacts to air quality from the Proposed Action would be associated with construction of the landing pad at SLC-4W, and with the boost-back and landing operations. The analysis involves estimating emissions generated from the proposed construction activities and assessing potential impacts on air quality, and estimating emissions associated with the boost-back and landing operations.

Significant air quality impacts would occur if implementation of any of the alternatives would directly or indirectly:

- Expose people to localized (as opposed to regional) air pollutant concentrations that potentially violate federal or state ambient air quality standards; and/or
- Exceed caps (limits) as imposed by federal and state GHG regulations. These regulations are in the draft stage, but would likely be in place during project construction.

On 18 February 2010, the CEQ released draft guidance on addressing climate change in NEPA documents. This draft document was revised on 18 December 2014, and CEQ solicited public comments until 23 Feb 2015. The 2010 draft guidance, which has been issued for public review and comment, recommends quantification of GHG emissions, and proposes a threshold of 25,000 metric tons of CO_2e emissions. The 2010 guidance indicates that use of 25,000 metric tons of CO_2e emissions as a reference point would provide federal agencies with a useful indicator, rather than an absolute standard of significance, to provide action-specific evaluation of GHG emissions and disclosure of potential impacts. This analysis complies with the recommendations of both the 2010 and 2014 versions of the draft guidance.

Standard dust control measures (see Section 2.3.4.1, Air Quality – 1 [Air-1]) must be implemented for any discretionary project involving earth-moving activities. Some projects have the potential for construction-related dust to cause a nuisance. Since Santa Barbara County violates the state standard for PM_{10}, dust mitigation measures are required for all discretionary construction activities regardless of the significance of the fugitive dust impacts based on the policies in the 1979 Air Quality Attainment Plan.

To determine the significance of operational impacts, emissions from the project were compared with the federal major source thresholds. The federal major source threshold for criteria pollutants is 100 tons per year, which is the major source threshold under 40 C.F.R. 70, the Federal Operating Permit Program, for all pollutants.

For purposes of this air quality analysis, project emissions within the VAFB region would be potentially significant if they exceed these thresholds. This is a conservative approach, as the analysis compares emissions from both project-related stationary and mobile sources to these thresholds.

If Proposed Action emissions were determined to increase ambient pollutant levels from below to above a national or state ambient air quality standard, these emissions would be significant.

4.1.1 Alternative 1 (Proposed Action)

4.1.1.1 SLC-4W Infrastructure Improvements

As discussed in Chapter 2 (Description of the Proposed Action and Alternatives), the Proposed Action includes construction of the concrete landing pad at SLC-4W. Construction is anticipated to require 90 to 120 days. During 30 days of this construction, concrete would be curing and minimal construction activities would occur. Construction emissions that would be associated with the Proposed Action include fugitive dust emissions from grading, exhaust emissions from heavy construction equipment, and emissions from worker vehicles and trucks. Table 4-1 lists the equipment that would be used for construction of the project.

To calculate emissions associated with construction, the CalEEMod Model, Version 2013.2.2 (ENVIRON 2013) was used. The CalEEMod Model is the latest version of the land use model in California, and takes into account emission factors for construction equipment from the CARB's OFFROAD model and emission factors for on-road vehicles from the CARB's EMFAC2011 model. As shown in Table 4-2, construction emissions would not exceed the significance thresholds for any criteria pollutant. The 24-hour CAAQS standard for PM_{10} has been recently exceeded at the Vandenberg station (Table 3-2); however, an increase of 0.05 tons per year in emissions would not have a substantial effect on the 24-hour standard or the annual standard and would not contribute significantly to any future exceedance. Nevertheless, dust mitigation measures would be implemented as required by the 1979 Air Quality Attainment Plan.

Furthermore, as discussed in Section 2.3.4 (Environmental Protection Measures), the Proposed Action would include EPMs to reduce impacts to the environment, including air quality.

All in-use heavy-duty diesel-fueled vehicles with a GVWR greater than 26,000 lb. (e.g., trucks and buses) must meet particulate matter best available control technology and engine model year emission requirements as specified in the CARB Regulation to Reduce Emissions of Diesel Particulate Matter, Oxides of Nitrogen and Other Criteria Pollutants from In-Use Heavy-Duty Diesel-Fueled Vehicles.

Equipment Description	Quantity	Make/Model or horsepower	Estimated Usage (days)*
Bulldozer	1	Caterpillar D-6	14
Excavator	1	Caterpillar 450	30
Vibratory drum compactor	1	6-foot sheepsfoot	30
Loader (2 cubic yards)	1	Caterpillar 950	30
Water truck	1	2,000 gal	30
Dump truck	1	12 yard	30
Pickup trucks (crew transportation)	2	Ford F250	30
Concrete pumping truck	1	300 hp diesel	7
Concrete hauling truck	5	300 hp diesel	7

* Estimated usage is based on 5 working days per week at 8 hours per day.

Table 4-1. Proposed Action Construction Emissions (tons/year)

Emissions, tons/year						
Construction Phase	**ROG**	**NO_x**	**CO**	**SO_x**	**PM_{10}**	**$PM_{2.5}$**
Site Preparation						
Fugitive Dust	-	-	-	-	0.0167	0.0091
Heavy Construction Equipment	0.0089	0.1007	0.0768	0.00006	0.0047	0.0043
Construction Worker Travel	0.0003	0.0005	0.0040	0.00001	0.0005	0.0001
Subtotal	**0.0092**	**0.1012**	**0.0808**	**0.0001**	**0.0219**	**0.0135**
Grading						
Fugitive Dust	-	-	-	-	0.0003	0.00003
Heavy Construction Equipment	0.0398	0.4440	0.2217	0.0005	0.0205	0.0189
On-road Diesel	0.00001	0.0002	0.0002	0.0000	0.00001	0.0000
Construction Worker Travel	0.0013	0.0022	0.0193	0.00003	0.0025	0.0007
Subtotal	**0.0411**	**0.4464**	**0.2412**	**0.0005**	**0.0233**	**0.0196**
Paving – Pad Construction						
Heavy Construction Equipment	0.0055	0.0483	0.0309	0.00005	0.0032	0.0030
On-road Diesel	0.0001	0.0009	0.0009	0.0000	0.0001	0.0000
Construction Worker Travel	0.0003	0.0004	0.0038	0.00001	0.0005	0.0001
Subtotal	**0.0059**	**0.0496**	**0.0356**	**0.0001**	**0.0038**	**0.0031**
Total Annual Emissions						
Total Annual Emissions	**0.0561**	**0.5972**	**0.3575**	**0.0006**	**0.0489**	**0.0363**
Significance threshold	100	100	100	100	100	100
Exceeds threshold?	No	No	No	No	No	No

Notes: CO = Carbon Monoxide, NO_x = Nitrogen Oxide, $PM_{2.5}$ = particulate matter less than 2.5 microns, PM_{10} = particulate matter less than 10 microns, ROG = reactive organic gases, SO_x = Sulfur Dioxide

4.1.1.2 Boost-Back and Landing at SLC-4W

As discussed in Chapter 2 (Description of the Proposed Action and Alternatives), SpaceX proposes to return the Falcon 9 Full Thrust First Stage to SLC-4W at VAFB for potential reuse. After the First Stage engine cutoff, exoatmospheric cold gas thrusters would be triggered to flip the First Stage into position for retrograde burn. Three of the nine First Stage Merlin engines would be restarted to conduct the retrograde burn to reduce the velocity of the First Stage and to place the First Stage in the correct angle to land. Once the First Stage is in position and approaching its landing target, the three engines would be cut off to end the boost-back burn. This part of the operation would occur above 3,000 ft. above ground level (AGL), and would not result in emissions within

the mixing layer. Therefore, emissions associated with the retrograde burn are not quantified in this analysis.

The First Stage would then perform a controlled descent using atmospheric resistance to slow the stage down and guide it to the landing pad target. The First Stage is outfitted with grid fins that allow cross range corrections as needed. The landing legs on the First Stage would then deploy in preparation for a final single engine burn that would slow the First Stage to a velocity of zero before landing on the landing pad at SLC-4W. Although propellants are expected to be burned to depletion during flight, there is a potential for a maximum approximately 7,000 lb. of LOX and a maximum of 2,750 lb. of RP-1 to remain in the Falcon 9 Full Thrust First Stage upon landing, based on prior landing events. Final volumes of fuel remaining in the First Stage upon landing may vary and would be included in the FSDP. Once the First Stage has landed and been secured, any remaining LOX and RP-1 would be properly off loaded and disposed or re-used.

Emissions associated with the launch of the Falcon 9 have been evaluated in the *Final Environmental Assessment Falcon 9 and Falcon 9 Heavy Launch Vehicle Programs from Space Launch Complex 4 East Vandenberg Air Force Base, California* (U.S. Air Force 2011a). Emissions below 3,000 ft. AGL associated with the landing would result from combustion of RP-1 during the final single engine burn, which is estimated to take place over approximately 17 seconds. Minor emissions of ROG would be associated with offloading of the remaining RP-1 fuel from the Falcon 9 fuel tank.

Seventy-seven percent of emissions from the Falcon rocket consist of N_2 and 20 percent consist of oxygen with the remaining three percent comprised of CO_2, CO, argon, and water vapor (U.S. Air Force 2007 and 2011a). Trace amounts of other pollutants could be emitted during launch operations; however, these amounts would be anticipated to be minor and would disperse after launch. It is estimated that approximately 4,000 lb. (1,810 kilograms) of RP-1 fuel would be consumed below 3,000 ft. AGL.

Measurements of criteria pollutant emissions presented in SpaceX (2007) estimate that a single launch of the Atlas V Heavy rocket would produce 1.2 tons of NO_x below 3,000 ft. (914.4 m) AGL. Only insignificant amounts of other criteria pollutants would be produced, and totals for those pollutants are reported as zero. Like the Falcon 9, the Atlas V Heavy rocket uses a mixture of RP-1 and LOX as fuel and is used here as a surrogate for estimating emissions from the boost-back landing of the Falcon 9 Full Thrust First Stage. As discussed in Chapter 2 (Description of the Proposed Action and Alternatives), it is anticipated that up to six landings per year would occur at SLC-4W. Estimated emissions per landing are presented in Table 4-3.

Operational emissions for all pollutants are below the federal major source threshold of 100 tons per year for all criteria pollutants; therefore, the Proposed Action would result in less than significant impacts to air quality. The SBCAPCD has adopted air quality significance thresholds, for projects subject to review under CEQA, that are much lower than the federal major source threshold. Any air quality permits required for the Proposed Action are subject to CEQA review by the SBCAPCD. The SBCAPCD's thresholds are contained in the SBCAPCD Environmental Review Guidelines and are available for review on the District's website at www.ourair.org/land-use/.

Table 4-2. Proposed Action Operational Emissions (tons/year)

Emissions, tons/year						
Operations	**ROG**	**NO_x**	**CO**	**SO_x**	**PM_{10}**	**$PM_{2.5}$**
Emissions per Landing	0	1.2	0	0	0	-
Total Emissions for 6 Landings/year	0	7.2	0	0	0	-

Notes: CO = Carbon Monoxide, NO_x = Nitrogen Oxide, $PM_{2.5}$ = particulate matter less than 2.5 microns, PM_{10} = particulate matter less than 10 microns, ROG = reactive organic gases, SO_x = Sulfur Dioxide

4.1.1.3 Contingency Drone Ship Landing

The process of landing the First Stage on a drone ship is the same as the process for landing on the SLC-4W pad at VAFB, and the emissions described associated with the landing would be the same as those described in Section 4.1.1.2 (Boost-Back and Landing at SLC-4W). The only difference is that gas emission would occur at least 31 mi. (50 km) offshore.

The three Merlin rocket engines used to position the First Stage for landing would be cutoff above 3,000 ft. AGL and would not result in emissions within the mixing layer. A final single engine burn would be used to slow the First Stage to a velocity of zero before landing on the drone ship. Although propellants would be burned to near depletion during flight, there is a potential for approximately 7,000 lb. of LOX and a maximum of 2,750 lb. of RP-1 to remain in the Falcon 9 Full Thrust First Stage upon landing. Final volumes of fuel remaining in the First Stage upon landing may vary and would be included in the FSDP. Once the First Stage has landed and been secured, any remaining LOX and RP-1 would be properly off loaded and transported to Long Beach Harbor for offloading and transport back to SLC-4W. Hazardous materials and ordnance would be offloaded from the First Stage after the drone ship is docked in Long Beach Harbor.

Emissions associated with the landing would result from combustion of RP-1 during the final single engine burn. Minor emissions of ROG would be associated with off-loading of the remaining RP-1 fuel from the Falcon 9 fuel tank (U.S. Air Force 2011a). As described in Section 4.1.1.2 (Boost-Back and Landing at SLC-4W), exhaust from the Merlin engines consists mainly of CO_2, CO, hydrogen, and water vapor. Trace amounts of other pollutants could be emitted during launch operations; however, we anticipate these amounts to be minor and would disperse after launch (U.S. Air Force 2007). Emissions associated with a drone ship landing would occur no less than 31 mi. (50 km) offshore of VAFB, but are otherwise the same as those for a landing on the SLC-4W pad (Table 4-3). Air emissions would take place outside the boundaries of any air district and beyond the limit of California Coastal Waters.

In additional to emissions from the First Stage rocket engine, the drone ship landing would result in air emission from the three vessels (drone ship, tug, and support vessel) as they transit between Long Beach Harbor and the landing site. The three vessels would be at-sea for approximately 72 hours, including 24 hours to transit to the landing site, 12 hours for pre-launch activation, 12 hours to secure the First Stage and equipment for the return trip, and 24 hours to transit back to Long Beach Harbor. The tug uses a 5,000 horsepower Tier 2 diesel engine, the support vessel has a 1,500 horsepower diesel engine, and the drone ship uses a 2,600 horsepower diesel engine. The drone ship engine would only be used for approximately 12 hours and would not be used when the drone ship is being towed or maneuvered by the tug. A 200-

kilowatt Tier 3 generator with a 9-liter engine located on the drone ship would be operating for the entire 72 hours. All three vessels and the generator run on diesel fuel. The average transit speed would be six knots.

The drone ship landing site would be located no closer than 31 mi. (50 km) from shore, and the vessels would be within the boundary of California Coastal Waters for approximately 43 hours of the total transit time (21.5 hours outbound and 21.5 hours inbound). Emissions from the operation of the three vessels would be below the major source threshold of 100 tons per year for all criteria pollutants (Table 4-4) and would result in less than significant impacts to air quality.

Table 4-3. Proposed Action Vessel Emissions for the Contingency Drone Ship Landing Within and Beyond California Coastal Waters (tons/year)

Emissions, tons/year					
Operations	**ROG**	**NO_x**	**CO**	**SO_x**	**PM_{10}**
Combined emissions for all three vessels per roundtrip transit (entire transit)	0.000474	0.011302	0.004198478	0.001417	0.000614
Combined emissions for all three vessels per roundtrip transit (CA Coastal waters only)	0.0003	0.0067	0.0025	0.0008	0.0004
Total emissions for six roundtrip transits/year (entire transit)	0.0028	0.0678	0.0252	0.0085	0.0037
Total emissions for six roundtrip transits/year (CA Coastal waters only)	0.0017	0.0405	0.0150	0.0051	0.0022

Notes: CO = Carbon Monoxide, NO_x = Nitrogen Oxide, $PM_{2.5}$ = particulate matter less than 2.5 microns, PM_{10} = particulate matter less than 10 microns, ROG = reactive organic gases, SO_x = Sulfur Dioxide

4.1.1.4 Summary of Impacts to Air Quality

A summary of potential impacts to air quality from all aspects of the Proposed Action is provided in Table 4-5. Air quality emissions associated with the launch of the Falcon 9 rocket were analyzed in the 2007 EA (U.S. Air Force 2007). Based on the analysis provided in the sections above, no significance thresholds would be exceeded.

Table 4-4. Summary of Annual Air Emission for the Proposed Action (tons/year)

Annual Emissions, tons/year for six launches and landings						
Operations	**ROG**	**NO_x**	**CO**	**SO_x**	**PM_{10}**	**$PM_{2.5}$**
Construction	0.0561	0.5972	0.3575	0.0006	0.0489	0.0363
First Stage Landings	0	7.2	0	0	0	-
Drone ship, tug, support vessel transit (within CA Coastal Waters)	0.0017	0.0405	0.0150	0.0051	0.0022	
Total	**0.0578**	**7.8377**	**0.3725**	**0.0016**	**0.0511**	**0.0363**
Significance threshold	100	100	100	100	100	100
Exceeds threshold?	No	No	No	No	No	No

Notes: CA = California, CO = Carbon Monoxide, NO_x = Nitrogen Oxide, $PM_{2.5}$ = particulate matter less than 2.5 microns, PM_{10} = particulate matter less than 10 microns, ROG = reactive organic gases, SO_x = Sulfur Dioxide

4.1.2 Alternative 2

Under Alternative 2, the landing pad at SLC-4W would not be constructed, and the boost-back and landing of the Falcon 9 Full Thrust First Stage would occur on a drone ship located approximately 320 mi. (515 km) west of VAFB. Air emissions associated with the rocket would be the same as those described in Section 4.1.1.3 (Contingency Drone Ship Landing). The only difference would be that emissions would occur 189 mi. (465 km) farther offshore. Air emissions from the drone ship, tug, and support vessel from the consumption of fuel would be approximately 10 times greater than emissions described for a drone ship landing, because the Proposed Action under Alternative 2 would take place approximately 10 times farther from shore than under Alternative 1. However, emissions within CA (California) state waters and the SBCAPCD would be the same as described in Section 4.1.1.3 (Contingency Drone Ship Landing), and air emissions would not exceed the significance threshold of 100 tons per year. Therefore, we anticipate no significant impact to air quality from the Proposed Action as implemented under Alternative 2.

4.1.3 No Action Alternative

Under the No Action Alternative, the landing pad at SLC-4W would not be constructed, and the boost-back and landing of the Falcon 9 Full Thrust First Stage would not occur. No additional impacts would be associated with the No Action Alternative; therefore, we anticipate no impact to air quality from the Proposed Action as implemented under the No Action Alternative.

4.1.4 Greenhouse Gas Emissions

4.1.4.1 Alternative 1 (Proposed Action)

Emissions of GHGs are considered to have a potential incremental impact on global climate. The emissions associated with construction of the landing pad at SLC-4W would incrementally increase regional emissions of CO_2 and other GHGs. Scientists are in general agreement that the Earth's climate is gradually changing, and that change is due, at least in part, to emissions of CO_2 and other GHG from anthropogenic sources.

On the issue of global climate change, however, there are no adopted federal plans, policies, regulations, or laws mandating reductions in the GHG emissions that cause global climate change. The climate change research community has not yet developed tools specifically intended to evaluate or quantify end-point impacts attributable to the emissions of GHGs from a single source. In particular, because of the uncertainties involving the assessment of such emissions regionally and locally, the incremental contribution of the Proposed Action to climate change cannot be determined given the current state of the science and assessment methodology.

On 18 February 2010, the CEQ released draft guidance on addressing climate change in NEPA documents. The draft guidance, which has been issued for public review and comment, recommends quantification of GHG emissions and proposes a threshold of 25,000 metric tons of CO_2e emissions. The CEQ indicates that use of 25,000 metric tons of CO_2e emissions as a reference point would provide federal agencies with a useful indicator, rather than an absolute standard of significance, for agencies to provide action-specific evaluation of GHG emissions and disclosure of potential impacts.

Under CEQA, the California Natural Resources Agency recently adopted amendments to the CEQA guidelines to address global climate change impacts. According to Appendix G of the CEQA Guidelines, the following criteria are considered to establish a significance threshold for GHG impacts:

Would the project:

- Generate GHG emissions, either directly or indirectly, that may have a significant impact on the environment?
- Conflict with an applicable plan, policy, or regulation adopted for the purpose of reducing the emissions of GHG?

As discussed in Section 15064.4 of the CEQA Regulations, the determination of the significance of GHG emissions calls for a careful judgment by the lead agency consistent with the provisions included therein. A lead agency should make a good-faith effort, based to the extent possible on scientific and factual data, to describe, calculate, or estimate the amount of GHG emissions resulting from a project. A lead agency shall have discretion to determine, in the context of a particular project, whether to:

> (1) Use a model or methodology to quantify GHG emissions resulting from a project, and which model or methodology to use. The lead agency has discretion to select the model or methodology it considers most appropriate provided it supports its decision with substantial evidence. The lead agency should explain the limitations of the particular model or methodology selected for use; or
>
> (2) Rely on a qualitative analysis or performance-based standards.

A lead agency should consider the following factors, among others, when assessing the significance of impacts from GHG emissions on the environment:

> (1) The extent to which the project may increase or reduce GHG emissions as compared to the existing environmental setting;

(2) Whether the project emissions exceed a threshold of significance that the lead agency determines applies to the project;

(3) The extent to which the project complies with regulations or requirements adopted to implement a statewide, regional, or local plan for the reduction or mitigation of GHG emissions. Such requirements must be adopted by the relevant public agency through a public review process and must reduce or mitigate the project's incremental contribution of GHG emissions. If there is substantial evidence that the possible effects of a particular project are still cumulatively considerable notwithstanding compliance with the adopted regulations or requirements, an EIR must be prepared for the project.

On 30 April 2015, the SBCAPCD adopted revisions to its Environmental Review Guidelines to the CEQA by adding significance thresholds for GHG impacts. The SBCAPCD has adopted a screening threshold of 10,000 metric tons of CO_2e per project per year. As a lead agency, the SBCAPCD is required to address the impacts of GHG emissions from the project as part of its CEQA review during the permitting process, should permits be mandated. Should emissions exceed the screening threshold, mitigation measures could be required to reduce emissions of GHGs.

For the Proposed Action, GHG emissions include emissions associated with construction of the landing pad at SLC-4W and the boost-back and landing of the Falcon 9 Full Thrust First Stage. Table 4-6 summarizes the annual GHG emissions associated with the Proposed Action. GHG emissions associated in construction of the landing pad at SLC-4W would produce 62.66 tons (56.84 metric tons) of CO_2e. These emissions would only occur during construction and would not contribute to annual GHG emissions beyond the first year. Only a small proportion of the emissions associated with the boost-back and landing event would have the potential to affect ambient air quality, which is defined as the area below the mixing height, typically defined as 3,000 ft. (914.4 m) AGL. The amount of CO_2e released by the re-landing would be between 60 and 88 percent less than a Falcon 9 launch, since only three engines would be re-lit, and only one would operate during landing (U.S. Air Force 2014b). For six boost-back First Stage landings per year, the amount of CO_2e produced would be 281.98 tons (255.81 metric tons) per year (Table 4-6). GHG emissions for the landing of the Falcon 9 Full Thrust First Stage on a drone ship located 31 mi. (50 km) from VAFB would be the same for boost-back and landing at SLC-4W, but with the additional emissions from the drone ship, tug, and support vessel. The maximum total GHG emissions for operation of these vessels, assuming six contingency landing events per year, would be 1,009.56 tons (915.86 metric tons) of CO_2e (Table 4-5).

Overall, the Proposed Action would produce a maximum of 1,354.20 tons (1,228.51 metric tons) of CO_2e during the first year (when construction is conducted) and a maximum of 1,291.55 tons (1,171.67 metric tons) annually thereafter, both of which are less than the SBCAPCD's significance threshold of 10,000 metric tons of CO_2e per year. Furthermore the vast majority of emissions would occur approximately 31 mi. (50 km) from shore, outside the boundary of California Coastal Waters. Finally, there would likely be less than six contingency landing events per year since the preferred option would be to land at SLC-4W. Therefore, emissions from the Falcon 9 Full Thrust First Stage landing would not have a significant adverse environmental impact on GHG emissions or climate change.

Table 4-5. Proposed Action GHG Emissions

Scenario/Activity	Total Metric Tons			
	CO_2	CH_4	N_2O	CO_2e
Total Construction GHG Emissions	56.51	0.0157	0	56.84
GHG Emissions Boost-Back and Landing per Event	42.58	0	0.0002	42.64
Total Annual GHG Emissions for 6 Landings/year	255.48	0	0.0011	255.81
GHG Emission for Drone Ship, Tug, and Support Vessel (per Contingency Landing event)	150.25	0.0015	0.008	152.64
Maximum Total Annual GHG Emissions for Drone Ship, Tug and Support Vessel (Assumes 6 Contingency Landings/year)	901.52	0.009	0.047	915.86
Maximum Total Annual GHG Emissions for the Proposed Action (Assumes 6 Contingency Landings/year)	**1,213.51**	**0.247**	**0.048**	**1,228.51**

Notes: CH_4 = methane, Co_2 = carbon dioxide, CO_2e = (CO_2 * 1) + (CH4* 21) + (N2O * 298), N_2O = nitrous oxide

4.1.4.2 Alternative 2

Under Alternative 2, the landing pad at SLC-4W would not be constructed, and the boost-back and landing of the Falcon 9 Full Thrust First Stage would occur on a drone ship located approximately 320 mi. (515 km) west of VAFB. Emissions of GHGs associated with the boost-back and landing of the Falcon 9 Full Thrust First Stage would be the same as those described in Section 4.1.4.1 (Alternative 1 [Proposed Action]). The only difference would be that emissions would occur approximately 189 mi. (465 km) farther offshore. GHG emissions from the drone ship, tug, and support vessel from the consumption of fuel would be approximately 10 times greater than emissions described for a drone ship landing, because the Proposed Action under Alternative 2 would take place approximately 10 times farther from shore than under Alternative 1. However, GHG emissions within CA state waters and the SBCAPCD would be the same as described in Section 4.1.4.1 (Alternative 1 [Proposed Action]), and would not exceed the significance threshold of 10,000 metric tons per year. Therefore, no significant impact on GHG emissions or climate change would be anticipated from the Proposed Action as implemented under Alternative 2.

4.1.4.3 No Action Alternative

Under the No Action Alternative, the landing pad at SLC-4W would not be constructed, and the boost-back and landing of the Falcon 9 Full Thrust First Stage would not occur. No additional impacts would be associated with the No Action Alternative; therefore, no significant impact to GHG emissions or climate change would be anticipated under the No Action Alternative.

4.2 Sound (Airborne)

The primary factor considered in determining potential noise impacts includes the extent or degree to which implementation of the Proposed Action would affect the baseline sound

environment. Concerns over noise include hearing loss, non-auditory health effects, annoyance, speech interference, and sleep interference. At elevated noise levels, people living in high noise environments for an extended period of time (40 years) can be at risk for hearing loss called Noise Induced Permanent Threshold Shift. DoD policy (Methodology for Assessing Hearing Loss Risk and Impacts in DoD Environmental Impact Analysis) requires that hearing loss risk be estimated for the at-risk population, defined as the population exposed to 80 DNL or greater. Specifically, DoD components are directed to use the 80 DNL noise contour to identify populations at the most risk of potential hearing loss. Boost-back and construction activities at VAFB do not generate noise at intensities that could contribute to hearing loss in people living near VAFB, so this issue is not further addressed. However, the potential effects would be conversation interruption, sleep interference, distraction, and annoyance. Based on numerous sociological surveys, and recommendations of federal interagency councils, the most common benchmark for assessing environmental noise impacts is a DNL of 65 dBA (Schomer 2005; Federal Interagency Committee on Noise 1992). When subjected to sound levels of 65 dBA DNL, approximately 12 percent of exposed individuals would be "highly annoyed." A sound level of 75 dBA DNL is a threshold above which effects other than annoyance can occur.

4.2.1 Approach to Analysis

Contours for boost-back noise were generated for activities performed under the Proposed Action. Additionally, construction noise propagation was evaluated for peak and hourly equivalent sound levels and compared against expected ambient noise levels.

Noise impacts from a project would be considered significant if a project were to generate noise levels in excess of 65 dBA DNL that could affect sensitive receptors, such as schools, residences, commercial lodging facilities, hospitals, or care facilities. Additionally, a significant noise impact would occur if the Proposed Action would cause noise sensitive areas to experience an increase in noise of annual DNL 1.5 dBA or more at or above DNL 65 dBA noise exposure when compared to the No- Action Alternative during the same time frame (FAA Order 1050.1).

Additionally, noise levels generated by sonic booms have the potential to break glass or damage structures. A significant impact from sonic booms would occur if there was a high risk or potential for glass to break or damage to structures due to the sonic boom. Sonic booms that generate an overpressure greater than 6 psf have the potential to cause this type of impact (Haber and Nakaki 1989; Plotkin et al. 2012). Sonic boom noise impacts are oriented along the path of a vehicle's trajectory.

4.2.2 Alternative 1 (Proposed Action)

4.2.2.1 SLC-4W Infrastructure Improvements

SpaceX's model for reusability requires that the landing pad be close enough to the launch site to support a timely processing of the recovered First Stage for subsequent launches. As part of this Proposed Action, SpaceX would construct a 300-ft. diameter concrete pad at the SLC-4W site (Figure 2-1). There is currently no flat area within SLC-4W that can support this configuration without site grading activities. Site grading is anticipated to be required to provide a flat compacted area to construct the concrete pad. Construction is anticipated to take 90–120 days.

During 30 days of this construction, concrete would be curing and minimal construction activities and noise would occur. Table 2-1 lists the equipment that would be used for construction of the project and Table 4-7 presents typical construction noise at various distances from the source.

The construction equipment would be used to create a concrete landing pad at SLC-4W, which is approximately 500 ft. (152.4 m) north of Spring Canyon. The construction site is well away from any sensitive receptors, with the main entry gate at Arguello Boulevard and West Ocean Avenue is which is approximately 4 mi. (6.4 km) to the northeast.

Construction activities would be a temporary source of local daytime sound. Given the distance from all construction locations to adjacent human sensitive receptors, noise levels from construction activities would not be audible above typical background noise levels. The noise-generating events from renovation activities would be intermittent; the contribution of renovation to the hourly sound levels (L_{eq}) is anticipated to be low (and thus, their contribution to the DNL). Sound levels up to 65 dBA DNL are considered to be compatible with land uses such as residences, transient lodging, and medical facilities. There are no human sensitive receptors impacted from sound as a result of construction activities under Alternative 1. Noise in excess of 65 dBA from construction activities would occur only on an intermittent basis, and only in areas immediately adjacent to the construction activities. Therefore, construction noise would not significantly affect the acoustic environment under Alternative 1.

Table 4-6. Typical Construction Noise Levels

Equipment	Typical Noise Level (dBA) 50 ft. (15.2 m) from source	Typical Noise Level (dBA) 500 ft. (152.4 m) from source	Approximate Noise Level (dBA) 0.5 mi. (804.6 m) from the source
Compactor	82	62	48
Concrete Mixer	85	65	51
Dozer	85	65	51
Excavator	81	61	47
Generator	81	61	47
Grader	85	65	51
Loader	85	65	51
Paver	89	69	55
Roller	74	54	40
Truck	88	68	54

Notes: dBA = decibel(s), A-weighted; ft. = foot/feet; m = meter(s)
Source: U.S. Department of Transportation 2006

4.2.2.2 Boost-Back and Landing at SLC-4W

Noise impacts would occur during landing of the Falcon 9 Full Thrust First Stage booster at SLC-4W, which takes place below an altitude of about 12,000 ft. (3,658 m) for a period of approximately 60 seconds. Noise levels at the landing site are expected to be between 110 and 120 dBA. Received noise levels above 90 dBA would occur on VAFB, but the contours would not extend beyond the base boundary. The western portion of Lompoc would be exposed to landing noise above 80 dBA but below 90 dBA, which is slightly lower than the noise of a passing motorcycle at 25 ft. (7.6 m) (Table 3-3). The remainder of the Lompoc area would be exposed to

noise levels above 70 dBA but not above 80 dBA, which is comparable to a passenger car traveling at 65 mph at 25 ft. (7.6 m) (Table 3-3). Given the short duration (typically 60 seconds) of the landing noise and the relatively low received noise levels at sensitive receptors, the contribution of launch noise would be minimal and unlikely that DNL levels would be elevated as a result of a single landing event. Additionally, landing noise impacts would be less than the impacts from the launch of the vehicle, which have previously been analyzed as having less than significant impacts to the noise environment (U.S. Air Force 2011a).

During descent of the First Stage, a sonic boom would be generated while the booster is supersonic. The overpressure would reach as high as 2.0 psf on VAFB and 3.1 psf on the Northern Channel Islands. The boom contours are generally broad forward-facing crescents. The majority of the boom occurs over the ocean. Overpressures would occur on shore in two areas: VAFB and immediate vicinity; and in a crescent from the northern Channel Islands in the ocean extending to the northeast over portions of Santa Barbara, Ventura, and Kern Counties.

At VAFB, sonic boom overpressures would be between 1.0 and 2.0 psf, and would not extend beyond the VAFB boundaries. Overpressures between 1.6 and 1.0 psf would extend off-base approximately 5 mi. (8.1 km) to the east, impacting the western portion of Lompoc. The 1.0 psf footprint extends approximately 12 mi. (19.3 km) beyond the VAFB boundary. Booms with overpressures of about 1 psf are generally audible and can startle people, but generally do not cause adverse effects such as damage to structures. Impacts to structures are typically considered significant at peak overpressures above 2.0 psf (Haber and Nakaki 1989; Plotkin et al. 2012).

One of the sonic boom overpressure crescents extends from the ocean to the northeast over portions of Santa Barbara, Ventura, and Kern Counties. While this crescent is extensive in distribution, the expected overpressure would be between 0.4 and 0.2 psf. A boom of that magnitude could be heard by someone who is expecting it and listening for it, but usually would not be noticed. Additionally, these overpressures do not cause adverse effects such as structure damage. Therefore, effects from the Boost-back and landing at SLC-4W would be less than significant.

4.2.2.3 Contingency Drone Ship Landing

Engine noise would be produced during the drone ship landing, but would be focused on an area well offshore of California. The sonic boom overpressure would be directed at the ocean and would reach as high as 2.0 psf. Portions of Santa Barbara County would experience sonic boom overpressures between 0.2 and 0.4 psf. Engine noise would also be produced during the landing of the Falcon 9 Full Thrust First Stage, but it would be less than the noise generated during a launch, and would occur over a shorter time period. The landing noise would fall below 70 dB at 10 mi. (6.1 km) from the landing site (Figure 2-11). Since the drone ship would be located 31 mi. (50 km) west of VAFB, there would be no impacts on shore and sensitive receptors located there.

Given that there are no changes to the launch processes at VAFB and noise from boost-back activities would occur well offshore of sensitive receptors, there would be no significant impacts associated with implementation of the contingency drone ship landing.

4.2.3 Alternative 2

Under this alternative, the construction of a landing pad at SLC-4W would not occur. Boost-back landing noise would occur from boost-back activities, but would be focused on an area well offshore of California. The sonic boom overpressure would be directed at the ocean and would reach as high as 2.0 psf. Engine noise would also be produced during the landing of the Falcon 9 Full Thrust First Stage, but it would be less than the noise generated during a launch, and would occur over a shorter time period. The landing noise would fall below 70 dB at 10 mi. (6.1 km) from the landing pad. Since the drone ship would be located 320 mi. (515 km) of site, there would be no noise impacts on shore.

Given that there are no changes to the launch processes at VAFB and noise from boost-back activities would occur well offshore of sensitive receptors, there would be no significant impacts associated with the implementation of Alternative 2.

4.2.4 No Action Alternative

Under the No-Action Alternative, the current launch processes at VAFB would continue without using the boost-back capabilities of the Falcon 9 Full Thrust First Stage, and without construction of the landing pad.

Launch noise under the No Action Alternative is intermittent and was previously analyzed (U.S. Air Force 2011a) but is presented here to facilitate comparison with boost-back activities. Four types of noise generally occur during a launch: (1) combustion noise from the launch vehicle chambers, (2) jet noise generated by the interaction of the exhaust jet and the atmosphere, (3) combustion noise from postburning of combustion products, and (4) sonic booms. The first three of these types of noise are often collectively referred to as “launch noise” and occur in the vicinity of the launch pad.

Acoustic levels versus distance from plume were modeled for the Falcon 9 and Falcon 9 Heavy launch vehicles (U.S. Air Force 2011a). Ground acoustic levels modeling completed for the Falcon 9 and Falcon 9 Heavy indicate that sound pressure levels fall below 100 dBA at 5.3 mi. (8.5 km) from the launch site for the Falcon 9, and 7.4 mi. (12 km) for the Falcon 9 Heavy (U.S. Air Force 2011a). Noise levels reaching Lompoc during a Titan IV launch were estimated to be between 100 and 104 dBA, and those reaching Santa Maria were estimated to be between 91 to 94 dBA. Noise from a Falcon 9 or Falcon 9 Heavy launch would be less than that from a Titan IV launch based on the noise modeling and thrust factors.

Sonic boom noise impacts typically occur downrange from the rocket launch pad and are orientated along the path of the vehicle’s trajectory, which for launches from VAFB are directed over the Pacific Ocean. Sonic booms produced by launches from VAFB would impact the ocean and have the potential to impact the main northern Channel Islands, located approximately 40 to 75 mi. (120.7 km) southeast of SLC-4E. The three main islands comprising the northern Channel Islands include San Miguel Island, Santa Rosa Island, and Santa Cruz Island.

Sonic boom modeling was also performed for the Falcon 9 vehicle (U.S. Air Force 2011a). The Falcon 9 modeling falls within the range seen from previous and current launch programs at VAFB and is well below the 8.97 psf level that occurred under the Titan IV program.

Based on noise modeling and sonic boom modeling for the Falcon 9 vehicle, impacts from the Falcon 9 program were concluded to be less than those from the Titan IV program and are anticipated to be less than significant (U.S. Air Force 2011a). Given that there are no changes to the current launch processes at VAFB, there would be no additional impacts associated with the implementation of the No Action Alternative.

4.3 Biological Resources

Factors considered in determining whether implementing an alternative may result in significant impacts on biological resources include the extent or degree to which implementation of an alternative would result in:

- Unmitigable loss of important quantities of declining vegetation communities (including wetlands) that are considered rare;
- Impacts to endangered, threatened, or protected species; or
- Alteration of regionally- and locally important wildlife corridors that would severely and permanently limit their use.

Impacts to biological resources would occur if species (endangered, threatened, rare, candidate, or species of concern) or their habitats, as designated by federal and state agencies, would be affected directly or indirectly by project-related activities. These impacts can be short- or long-term impacts, for example, short-term or temporary impacts from noise and dust during construction and demolition, and long-term impacts from the loss of habitat to support wildlife populations.

The USAF initiated formal Section 7 consultation with the USFWS to address potential adverse impacts to federally protected species, associated with the construction of the landing pad at SLC-4W. The completed consultation was in the form of a BO (BO 8-8-14-F-41) issued by USFWS (Appendix D) and the requirements would be fully implemented. Additionally, the USAF requested concurrence with a Not Likely to Adversely Affect determination associated with potential impacts to federally protected species associated with the boost-back and landing of the Falcon 9 Full Thrust First Stage at SLC-4W and a contingency landing action. The USFWS completed informal consultation and issued concurrence with the USAF determination (2015-I-0208; Appendix D).

VAFB initiated consultation for potential impacts to federally protected species under the jurisdiction of NOAA Fisheries for boost-back and landing of the Falcon 9 Full Thrust First Stage at the contingency landing action 31 mi. (50 km) offshore of VAFB in the Pacific Ocean. NOAA Fisheries concurred that the contingency landing action may affect, but is not likely to adversely affect federally protected species (2015/3042; Appendix E). The USAF also initiated informal consultation for potential impacts to Guadalupe fur seal under NOAA Fisheries jurisdiction as a result of the Proposed Action and NOAA Fisheries concurred that the action may affect, but is not likely to adversely affect the Guadalupe fur seal (Appendix E).

VAFB requested concurrence from NOAA Fisheries that the Proposed Action was likely to adversely affect EFH. NOAA Fisheries determined that the Proposed Action would adversely affect EFH. Therefore, NOAA Fisheries offered recommendations to avoid, minimize, mitigate, or

otherwise offset the adverse effects to EFH (2015/3042; Appendix E). Per these recommendations, SpaceX will contribute to a NOAA Fisheries approved marine debris removal program to offset impacts to EFH that may result from the Proposed Action.

SpaceX submitted an application to NOAA Fisheries for an Incidental Harassment Authorization (IHA) for Level B harassment to marine mammals protected under the MMPA on 29 January 2016. SpaceX is pursuing this IHA as a private entity. NOAA Fisheries is currently reviewing this application.

4.3.1 Alternative 1 (Proposed Action)

4.3.1.1 Botanical Resources

4.3.1.1.1 SLC-4W Infrastructure Improvements

Two habitat types were identified within the area to be impacted by landing pad construction activities: non-native grassland and mixed central coast scrub and non-native grassland. Both habitats are dominated by non-native plant species. Temporary and permanent disturbances to these habitat types would occur during construction. Permanent losses of 2.6 ac. (0.01 km^2) of non-native grassland and 0.4 ac. (0.002 km^2) of mixed central coast scrub and non-native grassland within the project area would occur as a result of construction of the landing pad.

No federal or state-listed plant species were documented within the footprint of the construction area during the botanical surveys. Seacliff buckwheat, the host plant of the federally endangered ESBB is, however, present. There would be no effects to federal or state-listed plant species as a result of implementing the Proposed Action, but seacliff buckwheat plants may be disturbed, damaged or destroyed as a result of construction activities. The USAF completed Section 7 consultation with the USFWS for potential impacts to ESBB habitat (BO 8-8-14-F-41) and would implement all applicable minimization, monitoring, and avoidance measures in this Biological Opinion and the EPMs described in Section 2.3.4.4 (Biological Resources – 2 [Bio-2]). Potential effects to ESBB habitat would therefore be less than significant.

4.3.1.1.2 Boost-Back and Landing at SLC-4W

Potential impacts to terrestrial botanical resources as a result to the boost-back and landing of the Falcon 9 Full Thrust First Stage would be limited to the potential for fire. A FireX system would utilize remote water cannons to promptly distinguish a resultant fire during landing at SLC-4W. Ground firefighting crews would also be present to move onto the site and distinguish resultant fires as soon as the site is cleared for access. As a result, there are no anticipated impacts to botanical resources as a result of the boost-back and landing of the Falcon 9 Full Thrust First Stage at SLC-4W.

4.3.1.1.3 Contingency Drone Ship Landing

Potential impacts as a result of the Contingency Action, boost-back and landing of the Falcon 9 Full Thrust First Stage 31 mi. (50 km) offshore would not include any terrestrial ground disturbance. Therefore, there are no anticipated impacts to botanical resources as a result of the Contingency Action.

4.3.1.2 Terrestrial Wildlife Resources

4.3.1.2.1 SLC-4W Infrastructure Improvements

Construction of the concrete pad at SLC-4W would result in the permanent loss of plant communities that provide habitat for common wildlife species. However, the small quantity of habitat (approximately 1.6 ac. [0.006 km^2]) that would be permanently lost would not measurably reduce regional populations of common wildlife species. No natural riparian or wetland habitat would be lost. Scattered shrubs within the site provide potential nesting bird habitat. Impacts to potential nesting bird habitat would be minimized with the EPMs outlined in Section 2.3.4.5 (Biological Resources 3 – [Bio-3]).

Temporary impacts to wildlife species may occur within adjacent wildlife habitat due to an increase in noise, dust, and other construction related disturbances. Temporary disturbances due to construction noise and human presence could disrupt foraging and roosting activities, or cause common bird and wildlife species to avoid the work area during construction periods. Temporary disturbances could also potentially result in the loss of wildlife species that are present during construction activities. Adult birds would likely move to adjacent suitable habitat due to project related disturbances and not be likely to experience direct physical effects. In addition, qualified biologists would be present during all construction and demolition activities during the wet season and additional minimization measures designed to protect nesting birds and native wildlife would be implemented (Section 2.3.4.5, Biological Resources 3 – [Bio-3]).

Wildlife species present in the area could be affected by construction and demolition noise. For airborne sound, one of the most useful measurements to assess the effects of noise is the one-hour average sound level, abbreviated L_{eq1H}. The L_{eq1H} can be thought of in terms of equivalent sound. For example, a L_{eq1H} of 45.3 dB is what would be measured if a sound measurement device were placed in a sound field of 45.3 dB for one hour. However, this is not what happens during real sound measurements. When a L_{eq1H} level of 45.3 dB is measured, the sound level has fluctuated above and below 45.3 dB, but the average during that hour is 45.3 dB. The L_{eq1H} is usually A-weighted unless specified otherwise. A-weighting is a standard filter used in acoustics that approximates human hearing and in many cases is the most appropriate weighting filter when investigating sound effects on wildlife as well as humans. L_{eq} measurements can also be specified for other time periods such as eight or 24-hour periods. Predictions of non-transient noise levels associated with activities such as those that would occur during the construction and demolition of a bridge for distances up to 0.5 mi. (0.8 km) are depicted in Table 4-7, with the assumption that equipment is located in one area and operating simultaneously.

The construction equipment used to create a concrete landing pad at SLC-4W would be a temporary source of disturbance to wildlife. Most wildlife species would avoid the construction area or have adapted to some level of ongoing human activity in the area. It is expected that most wildlife species would continue to use the adjacent areas in the intervals between disturbances. In addition, the EPMs described in Section 2.3.4.5 (Biological Resources 3 – [Bio-3]), would be implemented, therefore impacts to wildlife species would be less than significant.

4.3.1.2.2 Boost-Back and Landing at SLC-4W

Temporary disturbances to terrestrial wildlife species within the project area may occur during the Falcon 9 boost-back, landing and associated sonic boom. These disturbances would be short in duration and would vary by species. Amphibians may leave shelter sites increasing the potential for predation and desiccation. Wildlife responses to noise can be physiological or behavioral. Physiological responses can range from mild, such as an increase in heart rate, to more damaging effects on metabolism and hormone balance. Behavioral responses to man-made noise include attraction, tolerance, and aversion. Each has the potential for negative and positive effects, which vary among species and among individuals of a particular species due to temperament, sex, age, and prior experience with noise. Responses to noise are species-specific; therefore, it is not possible to make exact predictions about hearing thresholds of a particular species based on data from another species, even those with similar hearing patterns. Exceptionally little sound is transmitted between the air-water interface; thus, in-air sound would not have a significant effect on submerged animals (Godin 2008).

The Proposed Action would create landing noise and up to a 3.1 psf sonic boom on the Northern Channel Islands and a 2 psf sonic boom on VAFB and visual disturbances, which could cause temporary behavioral disruption to common wildlife species. These events would be infrequent and of short duration. Therefore, no significant impacts to wildlife species are anticipated.

4.3.1.2.3 Contingency Drone Ship Landing

Under the Contingency Action, landing noise would be sufficiently offshore so that it would not have any impact to terrestrial wildlife onshore. A sonic boom of up to 0.4 psf may impact land (Figure 2-10). As discussed above, a sonic boom may cause temporary physiological or behavioral disturbances to wildlife species. These disturbances would be short in duration and would vary by species and can range from mild, such as an increase in heart rate, to more damaging effects on metabolism and hormone balance. Each has the potential for negative and positive effects, which vary among species and among individuals of a particular species due to temperament, sex, age, and prior experience with noise. Responses to noise are species-specific; therefore, it is not possible to make exact predictions about hearing thresholds of a particular species based on data from another species, even those with similar hearing patterns. Exceptionally little sound is transmitted between the air-water interface; thus, in-air sound would not have a significant effect on submerged animals (Godin 2008).

4.3.1.3 Special Status Terrestrial Wildlife Species

4.3.1.3.1 SLC-4W Infrastructure Improvements

Construction and demolition activities may directly or indirectly affect migratory birds and the federally listed ESBB and CRLF. The EPMs described in Section 2.3.4.4 (Biological Resources 2 – [Bio-2]) and Section 2.3.4.5 (Biological Resources 3 – [Bio-3]), would be implemented to minimize potential impacts. A list of special status wildlife species is provided in Table 4-8.

Migratory Birds

Temporary impacts to birds protected by the MBTA may occur within adjacent habitat due to an increase in noise, dust, and other construction related disturbances. Temporary disturbances due

to construction noise and human presence could disrupt foraging and roosting activities, or cause bird species to avoid the work area during construction periods. As discussed above, predictions of non-transient noise levels associated with activities related to SLC-4W infrastructure improvements for distances up to 0.5 mi. (0.8 km). Temporary disturbances could also potentially result in the loss of bird species that are present during construction activities. Adult birds would likely move to adjacent suitable habitat due to project related disturbances and not be likely to experience direct physical effects. In addition, qualified biologists would be present during all construction and demolition activities and additional minimization measures designed to protect nesting birds and native wildlife would be implemented (Section 2.3.4.5, Biological Resources 3 – [Bio-3]).

Vegetation or structures that could support nesting native birds would be cleared or demolished outside of the bird nesting season or would be checked for active nests by a biological monitor prior to clearing. If eggs or chicks are found, construction would be delayed until after young had fledged. Adult birds are expected to move to adjacent suitable habitat due to construction related disturbances and are not likely to experience direct physical effects. As a result, potential effects to migratory birds from direct physical effects would be less than significant.

El Segundo Blue Butterfly

All life stages of the ESBB could be affected by the removal of their host plant, seacliff buckwheat during construction activities. When host plants are lost, individual ESBB larvae could be killed or injured as the plant is damaged or removed. Adult butterflies, if present, are expected to be able to move out of harm's way to suitable habitat available nearby. Although the seacliff buckwheat plants will be removed by mowing and the soil would not be disturbed beneath the plants, all ESBB pupae diapausing in the soil could be injured or killed through crushing by the mowing equipment. If ESBB were present, and diapausing pupae were not injured or killed by mowing equipment, emerging adults would potentially have the opportunity to disperse to nearby seacliff buckwheat plants. Once the 118 seacliff buckwheat plants located within SLC-4W are removed during site improvements, the site will be routinely mowed. Any seacliff buckwheat plants that may emerge between mowing events are not expected to grow large enough to provide habitat for ESBB.

Table 4-7. Potential Impacts to Special Status Wildlife within the Terrestrial Portion of the Proposed Action Area

Species		Status	Potential Impacts
Invertebrates			
El Segundo Blue Butterfly	(*Euphilotes battoides allyni*)	FE	Loss of potential habitat and mortality.
Amphibians			
California Red-legged Frog	(*Rana draytonii*)	FT, CSC	Disturbance from noise, vibration, & light.
Reptiles			
Western Pond Turtle	(*Antinemys pallida*)	CSC	Disturbance from noise, vibration, & light.
Blainville's Horned Lizard	(*Phrynosoma blainvillii*)	CSC	Loss of potential habitat; disturbance from noise, vibration, & light
Silvery Legless Lizard	(*Anniella pulchra pulchra*)	CSC	Loss of potential habitat; disturbance from vibration
Two-striped Garter Snake	(*Thamnophis hammondii*)	CSC	Disturbance from vibration, & light
Birds*			
California Brown Pelican	(*Pelecanus occidentalis californicus*)	FD, SD, FP	Disturbance from noise, vibration, & light.
Ferruginous Hawk	(*Buteo regalis*)	BCC	Disturbance from noise, vibration, & light.
Northern Harrier	(*Circus cyaneus*)	CSC	Loss of potential foraging habitat; disturbance from noise, vibration, & light.
White-tailed Kite	(*Elanus leucurus*)	CSC	Loss of potential foraging habitat; disturbance from noise, vibration, & light.
Golden Eagle	(*Aquila chrysaetos)*	BCC, FP	Disturbance from noise, vibration, & light.
Bald Eagle	(*Haliaeetus leucocephalus*)	BGEPA, FD, SE	Disturbance from noise, vibration, & light.
American Peregrine Falcon	(*Falco peregrinus anatum*)	FD, BCC, SD, FP	Disturbance from noise, vibration, & light.
Western Snowy Plover	(*Charadrius nivosus nivosus*)	FT, BCC, CSC	Disturbance from noise, vibration, & light.
Black Oystercatcher	(*Haematopus bachmani*)	BCC	Disturbance from noise, vibration, & light.
Long-billed Curlew	(*Numenius americanus*)	BCC	Disturbance from noise, vibration, & light.
California Least Tern	(*Sternula antillarum browni*)	FE, CSC	Disturbance from noise, vibration, & light.
Burrowing Owl	(*Athene cunicularia hypogea*)	BCC, CSC	Disturbance from noise, vibration, & light.
Allen's Hummingbird	(*Selasphorus sasin*)	BCC	Loss of potential foraging habitat; disturbance from noise, vibration, & light.
Nuttall's Woodpecker	(*Picoides nuttallii*)	BCC	Disturbance from noise, vibration, & light.
Olive-sided Flycatcher	(*Contopus cooperi*)	CSC	Disturbance from noise, vibration, & light.
Loggerhead Shrike	(*Lanius ludovicianus*)	BCC	Disturbance from noise, vibration, & light.
Purple Martin	(*Progne subis*)	CSC	Disturbance from noise, vibration, & light.
Oak Titmouse	(*Baeolophus inornatus*)	BCC	Loss of potential foraging habitat; disturbance from noise, vibration, & light.
Yellow Warbler	(*Dendroica petechia brewsteri*)	BCC, CSC	Disturbance from noise, vibration, & light.
Yellow-breasted Chat	(*Icteria virens*)	CSC	Disturbance from noise, vibration, & light.
Black-chinned Sparrow	(*Spizella atrogularis*)	BCC	Disturbance from noise, vibration, & light.
Savannah Sparrow	(*Passerculus sandwichensis* possible *beldingi*)	Possible SE	Disturbance from noise, vibration, & light.
Tricolored Blackbird	(*Agelaius tricolor*)	BCC, CSC	Disturbance from noise, vibration, & light.
Lawrence's Goldfinch	(*Spinus lawrencei*)	BCC	Disturbance from noise, vibration, & light.

Species		Status	Potential Impacts
Mammals			
Pallid Bat	(*Antrozous pallidus*)	CSC	Loss of potential foraging habitat; disturbance from noise, vibration, & light.
Townsend's Big-eared Bat	(Corynorhinus townsendii)	SC	Loss of potential foraging habitat; disturbance from noise, vibration, & light.
Western Red Bat	(*Lasiurus blossevillii*)	CSC	Loss of potential foraging habitat; disturbance from noise, vibration, & light.
Southern Sea Otter	(*Enhydras lutris nereis*)	FE	Disturbance from noise, vibration, & light.
American Badger	(*Taxidea taxus*)	CSC	Loss of potential habitat; disturbance from noise, vibration, & light.

Notes: FE = Federal Endangered Species, FT = Federal Threatened Species, FC = Federal Candidate Species, BCC = Federal Bird Species of Conservation Concern, BGEPA = Bald and Golden Eagle Protection Act, SE = State Endangered Species, CSC = California Species of Special Concern, SC = State Candidate Species, FP = California Fully Protected Species
* All birds listed in the table are also protected under the MBTA.

Although the number of seacliff buckwheat plants occurring on VAFB has not been estimated, the 0.04 acre (0.016 hectare) area where the 118 individual plants would be removed represents less than one hundredth of a percent of the 1,090 acres (441 hectares) of known occupied ESBB habitat on base.

Seacliff buckwheat habitat would be enhanced at a 2:1 ratio (habitat enhanced: habitat affected) to replace the buckwheat plants removed. While the distribution of seacliff buckwheat, both regionally and on VAFB, is greater than the known distribution of ESBB, in general, the butterfly is negatively affected by its host plants' competition with non-native vegetation. Therefore, the enhancement of seacliff buckwheat plants in an area designated by a biologist familiar with the habitat requirements of the ESBB should improve and add to the available habitat on VAFB. Implementation of these measures would result in less than significant impacts to ESBB as a result of construction of the landing pad at SLC-4W.

California Red-Legged Frog

Although unlikely under typical conditions, CRLF may be present in Spring Canyon, immediately south of the project area, in high rainfall years (ManTech SRS Technologies, Inc. 2013). It is therefore possible that CRLF could disperse through the project area and be present during construction and demolition activities. As a result, CRLF may be inadvertently killed or injured during construction and demolition activities if present. A qualified biological monitor would be present to survey the project site before activities, monitor operations that could affect CLRF when they may be present, and relocate CRLF to the nearest suitable habitat outside of the project area prior to the onset of construction activities.

Relocating CRLF out of harm's way may reduce injury or mortality from equipment, foot traffic, or ground disturbing activities; however, injury or mortality of individuals may occur as a result of improper handling, containment, or transport of individuals or from releasing them into unsuitable habitat (e.g., where exotic predators are present). Observations of diseased and parasite-infected amphibians are frequently reported. This has given rise to concerns that releasing amphibians following a period of captivity, during which time they can pick up infections of disease agents, may cause an increased risk of mortality in wild populations. Amphibian

pathogens and parasites can also be carried between habitats on the hands, footwear, or equipment of fieldworkers, which can spread them to localities containing species which have had little or no prior contact with such pathogens or parasites.

Construction noise is not likely to impact CRLFs because of the 1.53 mi. (2.5 km) distance between SLC-4W and the nearest occupied CRLF habitat. Excavation and backfilling associated with the construction of the landing pad and access roads may increase erosion that can lead to sedimentation that could smother CRLF or reduce the availability of plants and insects that serve as their habitat and food sources. Silt fencing would be installed between SLC-4W and Spring Canyon and BMPs would be implemented during project activities to minimize the effects of sedimentation resulting from the proposed project. These measures will control and minimize erosion and sedimentation and their effects on CRLF and habitat.

The populations of CRLF on VAFB are considered plentiful and many of the habitats on base are of high quality. Overall, the effects to the species and its habitat would be relatively minor and temporary. Therefore, construction of the landing pad at SLC-4W would result in less than significant impacts to CRLF

4.3.1.3.2 Boost-Back and Landing at SLC-4W

The boost-back and landing of the Falcon 9 Full Thrust First Stage would produce a visual disturbance, landing engine noise, and a pressure wave (sonic boom) that may cause short-term disruption of behavior and may elicit a startle response, resulting in temporary disturbance to special status wildlife species, including migratory birds and federally listed CRLF, LETE, and SNPL. These disturbances would be short in duration and would vary by species and can range from mild, such as an increase in heart rate, to more damaging effects on metabolism and hormone balance. Each has the potential for negative and positive effects, which vary among species and among individuals of a particular species due to temperament, sex, age, and prior experience with noise. Responses to noise are species-specific; therefore, it is not possible to make exact predictions about hearing thresholds of a particular species based on data from another species, even those with similar hearing patterns.

California Red-Legged Frog

Exceptionally little sound is transmitted between the air-water interface (Godin 2008). Thus, in air sound, as a result of the sonic boom and landing noise, is not likely to have a significant effect on submerged terrestrial reptiles or amphibians. The combined effect of visual and noise related disturbance would be expected to trigger a startle response in CRLF, causing them to flee to water or attempt to hide in place. Any animals that dive underwater would be less susceptible to acoustic effects (Godin 2008; USFWS 2011b). Since the noise generated by landing the Falcon 9 Full Thrust First Stage would be of short duration (approximately 25–35 seconds), and water would significantly buffer sound for any submerged animals, injury to hearing is highly unlikely. Similarly, a sonic boom of 2 psf is unlikely to result in hearing damage. Therefore, the effects of these visual and auditory stimuli are expected to only cause temporary disruption of CRLF behaviors, including potential temporary cessation of foraging or basking. During the breeding season, CRLF may stop calling, but would be expected to resume normal activities quickly once

the disturbance has ended. Additionally, water quality is not anticipated to be affected by project activities.

The USFWS concurred with the USAF determination that the Proposed Action may affect, but is not likely to affect the CRLF (2015-I-0208; Appendix D). Any potential adverse effects resulting from the Proposed Action would be insignificant (i.e., the size of the impact would be so small that a person would not be able to meaningfully measure, detect, or evaluate the effects) and discountable (i.e., the effects are extremely unlikely to occur).

California Least Tern

Engine landing noise at Purisima Point is expected to be approximately between 70 and 80 dBA and 80–90 dBA at the Santa Ynez River mouth (Figure 3-5). A sonic boom up to 0.2 psf is expected to impact Purisima Point (Figure 3-6). The Santa Ynez River mouth, as shown in Figure 3-6, may be impacted by a sonic boom of up to 1 psf (approximately 130 dB [unweighted]). LETE foraging and breeding areas are not within overflight zone of the boost-back. Visual disturbance is not anticipated as a result of the boost-back and landing due to the distance of the craft from Purisima Point and the Santa Ynez River mouth. In addition, the First Stage vehicle would remain above 1,000 ft. (305 m) for the majority of the landing. Flight below 1,000 ft. (305 km) would only occur for 5 seconds.

Monitoring of LETE has been conducted for five Delta II launches from SLC-2 on north VAFB. SLC-2 is 0.4 mi. (0.32 km) from the Purisima Point nesting colony and significantly closer than SLC-4, which is approximately 7.5 mi. (12.1 km) from the Purisima Point nesting colony (Figure 3-6). LETE response has been mixed. 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 as a result of the launches (ManTech SRS Technologies, Inc. 2007b, 2008a, 2011). The May and July 1997 Delta II launches, however, potentially caused the abandonment of up to five nests and the death of a chick due to exposure, although predation of adult LETE by owls may have been responsible for some of the losses observed (BioResources 1997). Given the distance from SLC-4 and the overflight zone to Purisima Point, and the fact that landing-related noise would be less than that of launch noise, it is unlikely that landing related noise would cause LETE to alter their behavior at Purisima Point. The Santa Ynez River area (3.7 mi. [5.9 km] north of SLC-4), occasionally used for foraging, may receive a significant amount of noise, including the impact of 1 psf sonic boom, which could briefly affect foraging behavior. These effects would be short-term and temporary and have no adverse effects.

The USFWS concurred with the USAF determination that the Proposed Action may affect, but is not likely to affect the LETE (2015-I-0208; Appendix D). Any potential adverse effects resulting from the Proposed Action would be insignificant (i.e., the size of the impact would be so small that a person would not be able to meaningfully measure, detect, or evaluate the effects) and discountable (i.e., the effects are extremely unlikely to occur).

Western Snowy Plover

SNPL may experience boost-back related noise in excess of 100 dBA and a sonic boom of up to 1.6 psf (approximately 130 dB [unweighted]). SNPL monitoring for impacts related to boost-back related engine noise and visual disturbance has been conducted during numerous past launches. Direct observations of wintering birds were made during a Titan IV and Falcon 9 launch from SLC-4E (SRS Technologies, Inc. 2006d; Robinette and Ball 2013). Both the Titan IV and Falcon 9 are larger, louder (130 dBA and 100 dBA respectively) launch vehicles than the Falcon 9 Full Thrust First Stage boost-back. SNPL did not exhibit any adverse reactions to these launches (SRS Technologies, Inc. 2006d; Robinette and Ball 2013). Additionally, monitoring of SNPL during the breeding and non-breeding season for other launches has routinely demonstrated that SNPL behavior is not adversely affected by launch noise or vibrations, and no incidents of injury or mortality to adults, young, or eggs have been documented following any of the launches (SRS Technologies, Inc. 2006a, 2006b, 2006c, 2006f, ManTech SRS Technologies, Inc. 2007a, 2008b, 2008c, 2009d).

Similar to LETE, due to the short-term, transient nature of anticipated boost-back and sonic boom noise and their lack of adverse responses to rocket launch noise, responses to boost-back noise are only anticipated to be behavioral. These behavioral reactions would be short term and temporary and adverse effects are not anticipated.

The USFWS concurred with the USAF determination that the Proposed Action may affect, but is not likely to affect the SNPL (2015-I-0208; Appendix D). Any potential adverse effects resulting from the Proposed Action would be insignificant (i.e., the size of the impact would be so small that a person would not be able to meaningfully measure, detect, or evaluate the effects) and discountable (i.e., the effects are extremely unlikely to occur).

4.3.1.3.3 Contingency Drone Ship Landing

Under the Contingency Action, landing noise would be sufficiently offshore so that it would not have any impact to special status wildlife species (Figure 2-11), including the southern sea otter which tend to remain nearshore, between shore and the 65 ft. (20 m) depth contour (USFWS 2003).

A sonic boom of up to 0.4 psf may impact land (Figures 2-9 and 2-10). As discussed above, a sonic boom may cause temporary physiological or behavioral disturbances to special status wildlife species. These disturbances would be short in duration and would vary by species and can range from mild, such as an increase in heart rate, to more damaging effects on metabolism and hormone balance. Each has the potential for negative and positive effects, which vary among species and among individuals of a particular species due to temperament, sex, age, and prior experience with noise. Responses to noise are species-specific; therefore, it is not possible to make exact predictions about hearing thresholds of a particular species based on data from another species, even those with similar hearing patterns. The effect of the sonic boom generated during the Contingency Action nearshore and onshore would be expected to be less for the SLC-4W landing since the overpressure would be significantly less powerful (up to 0.4 psf versus 2.0 psf). Exceptionally little sound is transmitted between the air-water interface; thus, in-air sound would not have a significant effect on submerged animals (Godin 2008). As a result,

activities associated with the Contingency Action of Alternative 1 are not expected to have a significant effect on special status wildlife species.

4.3.1.4 Marine Mammals

The marine mammal species that may be found within areas potentially affected by the Proposed Action include up to 28 cetaceans and six pinnipeds, as well as the southern sea otter. The potential impacts to these species as a result of the Proposed Action are analyzed below.

NOAA Fisheries has developed interim sound threshold guidance for received sound pressure levels from broadband sound that may cause behavioral disturbance and injury in the context of the MMPA (Table 4-9; NOAA Fisheries 2015). In addition, NOAA Fisheries provided sound threshold guidance for in-water explosives (Table 4-10; Carduner 2015). These thresholds were used to determine the potential geographic area where acoustic impacts to marine mammals from the boost-back and landing actions would be possible.

4.3.1.4.1 SLC-4W Infrastructure Improvements

Construction of the concrete landing pad at SLC-4W is within terrestrial habitat and relatively far from the nearest haul out location (4.3 mi. [7.0 km], Figure 3-8) and thus would have no potential impact on marine mammals, such as pinnipeds or sea otters.

4.3.1.4.2 Boost-Back and Landing at SLC-4W

The boost-back of the Falcon 9 Full Thrust First Stage at SLC-4W would generate landing noise, visual stimuli, and a sonic boom that could disturb marine mammals protected under the ESA and MMPA (southern sea otter, pinniped species, and cetacean species). The MMPA defines Level B harassment as any act of pursuit, torment or annoyance which has the potential to disturb a marine mammal stock in the wild by causing disruption of behavioral patterns, including but not limited to migration, breathing, nursing, breeding, feeding, or sheltering. NOAA Fisheries believes the potential for such disruption, from in-air noise, is extremely unlikely for animals that are at sea. Cetaceans spend their entire lives in the water and spend most of their time (>90 percent for most species) entirely submerged below the surface. Additionally, when at the surface, cetacean bodies are almost entirely below the water's surface, with only the blowhole exposed to allow breathing. This minimizes in-air noise exposure, both natural and anthropogenic, essentially 100% of the time because their ears are nearly always below the water's surface. As a result, in-air noise caused by sonic boom and landing engine noise at SLC-4W would not have an effect on cetacean species. Pinnipeds, however, spend significant amounts of time out of the water during breeding, molting, and hauling out periods, therefore the potential effects of in-air noise generated during the boost-back and landing of the Falcon 9 Full Thrust First Stage at SLC-4W on pinniped species at haul outs are analyzed below. Southern sea otter locations along the coast of mainland California would also be impacted by the sonic boom generated during a SLC-4W landing and are discussed below.

Table 4-8. NOAA Fisheries Interim Sound Threshold Guidance[1]

Criterion	Criterion Definition	Threshold
In-Water Acoustic Thresholds		
Level A	PTS (injury) conservatively based on TTS	190 dB_{rms} for pinnipeds 180 dB_{rms} for cetaceans
Level B	Behavioral disruption for impulsive noise	160 dB_{rms}
Level B	Behavioral disruption for non-pulse noise	120 dB_{rms}
In-Air Acoustic Thresholds		
Level A	PTS (injury) conservatively based on TTS	None established
Level B	Behavioral disruption for harbor seals	90 dB_{rms}
Level B	Behavioral disruption for non-harbor seal pinnipeds	100 dB_{rms}

[1] Carduner 2015

Notes: dB = decibel(s), rms = root mean squared, PTS = Permanent Threshold Shift, TTS = Temporary Threshold Shift

Table 4-9. NOAA Fisheries Sound Threshold Guidance for In-Water Explosives[1]

Group	Species	Level B		Level A			Mortality
		Behavioral (for ≥ 2 pulses/24 hours)	TTS	PTS	Gastro-Intestinal Tract Injury	Lung Injury	
Low-Frequency Cetaceans	Mysticetes	167 dB SEL	172 dB SEL or 224 dB peak SPL	187 dB SEL or 230 dB peak SPL	104 psi (237 dB SPL)	**39.1 $M^{1/3}$ $(1+[D_{Rm}/10.081]^{1/2}$** Pa-sec Where: M=mass of the animal in kg **D_{Rm}=depth of the receiver in meters**	**91.4 $M^{1/3}$ $(1+[D_{Rm}/10.081]^{1/2}$** Pa-sec Where: M=mass of the animal in kg **D_{Rm}=depth of the receiver in meters**
Mid-Frequency Cetaceans	Most delphinids, medium & large toothed whales	167 dB SEL	172 dB SEL or 224 dB peak SPL	187 dB SEL or 230 dB peak SPL			
High-Frequency Cetaceans	**Porpoises and *Kogia* spp.**	141 dB SEL	146 dB SEL or 195 dB peak SPL	161 dB SEL or 201 dB peak SPL			
Phocids	Elephant & harbor seal	172 dB SEL	177 dB SEL or 212 dB peak SPL	192 dB SEL or 218 dB peak SPL			
Otariids	Sea lions & fur seals	195 dB SEL	200 dB SEL or 212 dB peak SPL	215 dB SEL or 218 dB peak SPL			

[1] Carduner 2015

Notes: ≥ = greater than or equal to, dB = decibel(s), psi = pound(s) per square inch, PTS = Permanent Threshold Shift, SEL = Sound Exposure Level, SPL = Sound Pressure Level, TTS = Temporary Threshold Shift

Pinniped Species

Sonic Boom

During the return flight of the Falcon 9 Full Thrust First Stage at SLC-4W, a sonic boom up to 2.0 psf would impact pinniped haul outs on VAFB (Figure 3-8) and a sonic boom up to 3.1 psf may impact haul outs on San Miguel, Santa Rosa, and Santa Cruz Islands (Figure 3-10). The sonic boom is expected to cause variable levels of disturbance to pinnipeds that may be hauled out within the area of exposure, depending on the species exposed and the level of the sonic boom. The USAF has monitored pinnipeds during launch-related sonic booms on the Northern Channel

Islands during numerous launches over the past two decades and determined that there are generally no significant behavioral disruptions caused to pinnipeds by sonic booms less than 1.0 psf (reviewed in Marine Mammal Consulting Group and Science Applications International Corporation 2013). Even above 1.0 psf, only a portion of the animals present tend to react to sonic booms. 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. Guadalupe fur seals also tend to be less sensitive to disturbance than other pinniped species (Harris 2015). Monitoring of past sonic booms have shown that normal behavior and numbers of hauled out pinnipeds typically return to normal within 24 hours or less after a launch event. Any observations of injury or mortality of pinnipeds during monitoring have not been attributable to past launches.

Reactions of pinnipeds to sonic booms have ranged from no response to heads-up alerts, from startle responses to some movements on land, and from some movements into the water to, in rare cases, stampedes. Behavioral reactions to noise can be dependent on relevance and association to other stimuli. A behavioral decision is made when an animal detects increased background noise, or possibly when an animal recognizes a biologically relevant sound. An animal's past experience with the sound-producing activity or similar acoustic stimuli can affect its choice of behavior. Competing and reinforcing stimuli may also affect its decision. Other stimuli present in the environment can influence an animal's behavior decision. These stimuli can be other acoustic stimuli not directly related to the sound-producing activity; they can be visual, olfactory, or tactile stimuli; the stimuli can be conspecifics or predators in the area; or the stimuli can be the strong drive to engage in a natural behavior.

Competing stimuli tend to suppress behavioral reactions. For example, an animal involved in mating or foraging may not react with the same degree of severity to acoustic stimuli as it may have otherwise. Reinforcing stimuli reinforce the behavioral reaction caused by acoustic stimuli. For example, awareness of a predator in the area coupled with the acoustic stimuli may illicit a stronger reaction than the acoustic stimuli itself otherwise would have. The visual stimulus of the Falcon 9 Full Thrust First Stage will not be coupled with the sonic boom, since the First Stage will be at significant altitude when the overpressure impacts land. This would decrease the likelihood and severity of a behavioral response.

Figures 3-9 and 3-10 show haul out sites on the mainland coast of central California and the Northern Channel Islands that would be affected by sonic booms during a SLC-4W landing. Pacific harbor seals, northern elephant seals, California sea lions, and Steller sea lions utilize the haul outs near Point Arguello and Point Conception. Within the affected area on the Northern Channel Islands (San Miguel, Santa Rosa, and Santa Cruz Islands), Pacific harbor seals, northern elephant seals, California sea lions, and northern fur seal use haul outs in relatively large numbers. Guadalupe fur seals are also observed in very low numbers at San Miguel Island.

SpaceX submitted an application for an IHA to NOAA Fisheries to incidentally take by Level B harassment Pacific harbor seals, northern elephant seals, California sea lion, Stellar sea lion, northern fur seal, and Guadalupe fur seal as a result of the boost-back and landing of the Falcon 9 Full Thrust First Stage at SLC-4W. NOAA Fisheries is currently reviewing the application.

Guadalupe fur seals are relatively insensitive to disturbance, occur in low numbers and isolated locations, and are adept at jumping into the water in the event that they do flee from a disturbance (Harris 2015). VAFB determined that the impacts from sonic boom as a result of boost-back and landing at SLC-4W were not likely to adversely affect the ESA-listed Guadalupe fur seal. NOAA Fisheries concurred that the action may affect, but is not likely to adversely affect the Guadalupe fur seal (2016/4011; Appendix E).

Mortality or injury to pinnipeds is not anticipated to occur. As a result, the sonic boom generated by the Falcon 9 Full Thrust First Stage during the boost-back and landing at SLC-4W would not have a significant effect on pinnipeds.

Landing Noise and Visual Disturbance

During landing at SLC-4W, the engines will generate pulse engine noise up to 110 dB re 20 µPa while landing on the pad at SLC-4W (Figure 3-8). This landing noise event would be of short duration (17 seconds). Landing noise between 70 and 90 dB would overlap pinniped haul outs at and near Point Arguello and haul outs at Purisima Point (Figure 3-8). NOAA Fisheries interim guidance thresholds for in-air acoustic impacts resulting in Level A harassment have not been established (Table 4-9; NOAA Fisheries 2015). However, NOAA Fisheries has established interim guidance for Level B harassment for harbor seals (90 dB; Table 4-9; NOAA Fisheries 2015) and for non-harbor seal pinnipeds (100 dB; Table 4-9; NOAA Fisheries 2015). There are no pinniped haul outs within the area impacted by landing noise at 90 dB or greater for a SLC-4W landing (Figure 3-8). In addition, the trajectory of the return flight includes a nearly vertical descent in both the SLC-4W and contingency drone ship landings (Figure 2-3). As a result, there would be no significant visual disturbance since it would either be shielded by coastal bluffs or too far away to cause significant stimuli. Therefore, landing noise and visual disturbance associated with the Falcon 9 Full Thrust First Stage boost-back will not result in Level B harassment or have significant effects on marine mammals.

Southern Sea Otter

Areas where sea otters may be present would be impacted by landing noise and sonic boom noise of up to 135 dB. Sea otter rafting areas off Purisima Point and Sudden Flats are projected to receive a sonic boom with pressure levels between 1 and 1.6 psf (Figure 3-7). Additionally, otters in transit along the coast southwest of SLC-4 may be impacted by a sonic boom as high as 2 psf (Figure 3-7). The response to sonic booms or other sudden disturbances is similar among many species (Moller 1978). Sudden and unfamiliar sounds usually act as an alarm and trigger a “fight or flight” startle reaction. However, sonic booms are not expected to cause more than a temporary startle-response because the “pursuit” would not be present, as monitoring sea otters during launch operations has indicated that launch noise is not a primary driver of sea otter behavior. Additionally, USFWS has stated that they had no evidence that defense-related activities have had any adverse effects on the well-monitored experimental population of southern sea otters at San Nicolas Island or in the Southern California Range Complex (USFWS 2011).

Launch monitoring of sea otters on both north and south VAFB has been extensive, with pre- and post-launch counts and observations conducted at rafting sites immediately south of Purisima

Point for numerous Delta II launches from SLC-2 and one Taurus launch from SLC-576 (Taurus launch site), and at the rafting sites off of Sudden Flats for two Delta IV launches from SLC-6. No abnormal behavior, mortality, or injury has ever been documented for sea otter as a result of launch-related disturbance (SRS Technologies, Inc. 2006a, 2006b, 2006c, 2006d, 2006e, 2006f, 2007; ManTech SRS Technologies, Inc. 2007a, 2007b, 2007c, 2008a, 2008b, 2008c, 2008d, 2008e, 2009c, 2009d, 2010). During the Delta IV launches, the number of sea otters observed after launch activities was similar to or greater than pre-launch counts. Given these observations, any launch-related effects on sea otter populations are likely negligible and temporary. In addition, the past launches during which monitoring of sea otters was conducted involved launch vehicles that produced louder noise than the boost-back is expected to produce.

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

Sounds from rocket launches are typically at a maximum at initiation of the booster rockets. These sounds (including any sonic booms from supersonic flight) would be transient and of short duration, lasting no more than a few seconds at any given location. Launch and boost-back activities may expose sea otters to levels of sound that could produce brief startle reactions or diving. However, while a 2 psf boom is approximately 135 dB (unweighted), it is likely that most of that acoustic energy is not heard by sea otters. Figure 4-1 illustrates the frequency spectrum of a 1.5 psf sonic boom (recorded at San Nicholas Island on 12 December 2014) as well as the hearing curve of a sea otter (Ghoul and Reichmuth 2014). Most of the sonic boom energy is less than 250 Hz, well below the region of best sensitivity of the sea otter (2–22.6 kHz; Figure 4-1). While the sea otter would likely hear the sonic boom, it would only be responding to acoustic energy that is above 250 Hz and total sound levels much less than 135 dB.

Due to the short-term, transient nature of anticipated boost-back and sonic boom noise, lack of overlap of hearing sensitivity with majority of sonic boom noise, and their lack of adverse responses to rocket launch noise, the Proposed Action is not expected to cause more than a temporary startle-response, and adverse effects are not anticipated.

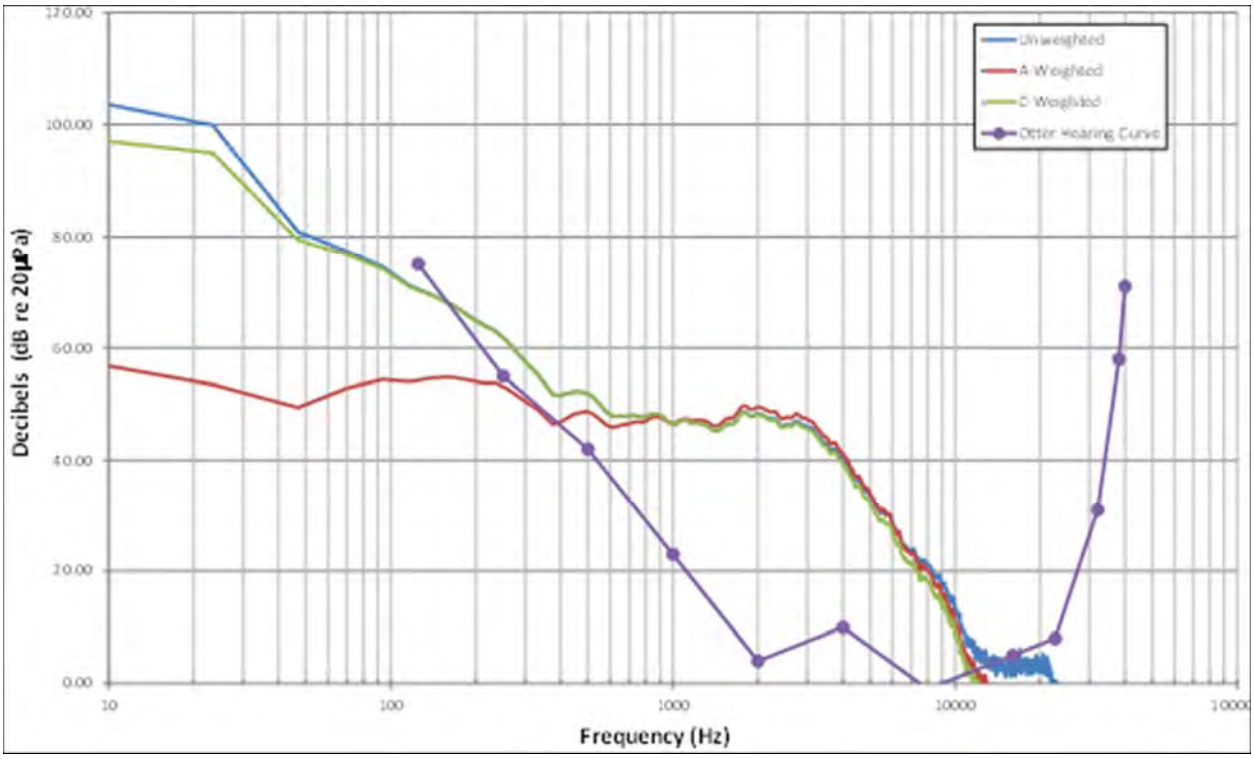


Figure 4-1. Sonic Boom Spectrum and Sea Otter Hearing Sensitivity Curve

The USFWS concurred with the USAF determination that the Proposed Action may affect, but is not likely to affect the southern sea otter (2015-I-0208; Appendix D). Any potential adverse effects resulting from the Proposed Action would be insignificant (i.e., the size of the impact would be so small that a person would not be able to meaningfully measure, detect, or evaluate the effects) and discountable (i.e., the effects are extremely unlikely to occur).

4.3.1.4.3 Contingency Drone Ship Landing

The return flight of the Falcon 9 Full Thrust First Stage during a contingency drone ship landing would not produce a significant sonic boom or engine noise that would impact any haul out locations (Figure 2-9 and Figure 2-10). Likewise, in-air noise that would be generated in the event of an explosion of the Falcon 9 Full Thrust First Stage would not reach haul out locations (Figure 2-11). The Contingency Action includes three potential impacts that may cause adverse effects to marine mammals occurring in the vicinity of the contingency landing site. These include potential debris strike, acoustic impacts, and interactions with expended materials, which are summarized in Table 4-12 at the end of this section. These impacts are analyzed below.

Debris Strike

Under the Contingency Action, in the event of an unsuccessful drone ship landing, the booster is expected to explode upon impact with the drone ship. The maximum estimated remaining fuel and oxidizer onboard the booster when it explodes would be the equivalent a net explosive weight of 503 lb. of TNT, although differing from TNT in brisance (i.e., shattering capability of a

high explosive). The resulting explosion of the estimated onboard remaining fuel would be capable of scattering debris a maximum estimated range of approximately 1,250 ft. (384 m) from the landing point and thus spread over a radial area of 114 ac. (0.46 km^2) as an impact area. Based on engineering analysis collected during a flight anomaly that occurred during a Falcon 9 test at SpaceX's Texas Rocket Development Facility, debris would impact 0.17 ac. (0.000706 km^2) of the total 114 ac. (0.46 km^2) impact area.

Using a statistical probability analysis for estimating direct air strike impact developed by the U.S. Navy (U.S. Department of the Navy 2014b) the probability of impact of debris with a marine mammal (*P*) can be estimated for individual marine mammals of each species that may occur in the impact footprint area (*I*) (0.000706 km^2). For this analysis we assumed a dynamic scenario with broadside collision, in which the width of the impact footprint is enhanced by a factor of five (5) to reflect forward momentum created by an explosion (U.S. Department of the Navy 2014b). Forward momentum typically accounts for five object lengths, thus the applied factor of five (5) area (U.S. Department of the Navy 2014b).

The probability of impact with a single animal (*P*) is calculated as the likelihood that an animal footprint area (*A*, defined as the adult length [L_a] and width [W_a] for each species) intersects the impact footprint area (*I*) within the overall "testing area" (*R*). Note that to calculate (*P*) it is assumed that the animal is in the testing area. For the purposes of this model, *R* was estimated as the maximum range of debris spread as a result of the First Stage explosion at the landing location (0.46 km^2). The probability impact with a single animal (*P*) depends on the degree of overlap of *A* and *I*. To calculate this area of overlap (A_{tot}), a buffer distance is added around *A* that is equal to one-half of the impact area (0.5**I*). This buffer accounts for an impact with the center of the object anywhere within the combined area of overlap (A_{tot}) would result in an impact with the animal. A_{tot} is then calculated as $(L_a + 2*W_i)*(W_a + (1 + 5)*L_i)$, where W_i and L_i are the length and width of the impact area (*I*). We assumed that $W_a = W_i$ = square root of *I*. The single animal impact probability (*P*) for each species is then calculated as the ratio of total area (A_{tot}) to testing area (*R*): $P = A_{tot}/R$. This single animal impact probability (*P*) is then multiplied by the number of animals expected in the testing area (*N* = density * *R*) to estimate the probability of impacting an individual for each species per event (*T*).

SpaceX proposes to conduct up to six contingency offshore landings per year, which may result in between zero and six explosions of the First Stage. In the model presented herein, we assume that the maximum of six events per year result in an explosion. This is a conservative estimate, since the actual number of contingency landing events resulting in the First Stage explosion is likely to be less than six.

The modeling results, as applied to the contingency landing actions, are presented below. Table 4-11 presents results based on estimated at-sea densities for each species (see Section 2, Description of the Proposed Action and Alternatives).

For ESA-listed marine mammals, modeling based on the estimated density of individuals for each species result in estimates of the probability of a direct strike of debris with an individual during each event of 0.0002 or less, (Table 4-11). The estimated number of takes for each species annually, assuming the maximum of six that result in explosion of the First Stage, was approximately 0.001 or less (Table 4-11). With the intentionally conservative overestimation of

parameters and assumptions in the model, the results indicate that it is extremely unlikely the explosion of the First Stage booster would result in debris impacting the ESA-listed species. These probabilities are sufficiently low to reasonably conclude that it would be unlikely that any of the seven ESA-listed marine mammals would be struck by debris as a result of conducting up to six contingency landings per year that result in explosion of the Falcon 9 Full Thrust First Stage. As a result, the potential debris strike of First Stage explosion may affect, but is not likely to adversely affect, the seven ESA-listed marine mammals: Guadalupe fur seal, blue whale, fin whale, gray whale, humpback whale, sei whale, and sperm whale. For marine mammals protected under the MMPA, the probability of debris strike for individuals of all species was also negligible (Tables 4-11) and therefore the potential debris strike as a result of Falcon 9 Full Thrust First Stage explosion would not have a significant effect on these species.

Table 4-10. Estimated At-Sea Density of Individuals per km^2, Probability of Direct Impact of Rocket Debris per Event, and Estimated Number of Takes

Species	Estimated At-Sea Density (km^2)*	Probability of Impact per Event (*T*)	Estimated Number of Impacts per year^
Harbor Seal	0.0200	0.0002	0.0010
California Sea Lion	2.5000	0.0222	0.1330
Northern Elephant Seal	0.0500	0.0005	0.0030
Steller Sea Lion	0.0001	0.0000008	0.000005
Northern Fur Seal	0.005	0.00004	0.003
Guadalupe Fur Seal#	0.0070	0.00006	0.0003
Humpback Whale#	0.0169	0.0002	0.001
Blue Whale#	0.0102	0.0001	0.0008
Fin Whale#	0.0132	0.0002	0.0010
Sei Whale#	0.00009	0.000001	0.000006
Bryde's Whale	0.00001	0.0000001	0.0000006
Minke Whale	0.0007	0.000007	0.00004
Gray Whale#	0.0024	0.00003	0.0002
Sperm Whale#	0.0085	0.0001	0.0006
Pygmy Sperm Whale	0.0010	0.000009	0.00005
Dwarf Sperm Whale	0.0010	0.000009	0.00005
Killer Whale	0.0007	0.000007	0.00004
Short-Finned Pilot Whale	0.0003	0.000003	0.00002
Long-Beaked Common Dolphin	0.6870	0.00612	0.0367
Short-Beaked Common Dolphin	1.3190	0.0117	0.0703
Common Bottlenose Dolphin	0.7140	0.0065	0.0392
Striped Dolphin	0.0300	0.0003	0.0016
Rough Toothed Dolphin	0.0010	0.000008	0.00005
Pacific White-Sided Dolphin	0.7500	0.0067	0.0400
Northern Right-Whale Dolphin	0.1070	0.0013	0.0075
Risso's Dolphin	0.2000	0.0018	0.0110
Dall's Porpoise	0.0550	0.0005	0.0029
Cuvier’s Beaked Whale	0.0050	0.00005	0.0003
Baird's Beaked Whale	0.0015	0.00002	0.0001
Blainville's Beaked Whale	0.0001	0.000001	0.000006
Ginkgo-toothed Beaked Whale	0.0003	0.000003	0.00002
Perrin’s Beaked Whale	0.0010	0.00001	0.00006
Stejneger’s Beaked Whale	0.0010	0.000009	0.00006

Hubbs' Beaked Whale	0.0010	0.000009	0.00006
Pygmy Beaked Whale	0.0003	0.000003	0.00002

* U.S. Department of the Navy 2014a.

^ Based on up to six events per year.

ESA-listed species.

Note: km^2 = square kilometer(s)

Underwater Acoustic Impacts

Underwater sounds can be organized into two types: impulse and non-impulse sounds. Impulse sounds may include sonic boom from First Stage boost-back and explosion of First Stage landing during an unsuccessful drone ship landing. Non-impulse noise would include engine noise from First Stage landing and vessel noise from the drone ship, tug, and support vessel.

NOAA Fisheries has developed interim sound threshold guidance for received sound pressure levels from broadband sound that may cause behavioral disturbance and injury in the context of the MMPA (Tables 4-9 and 4-10). These interim thresholds were used to determine the potential geographic area where acoustic impacts to marine mammals from the boost-back and landing actions would be possible. The type, intensity, and frequency of the sound measured at the receiver (i.e., the animal) is compared to the acoustic criteria to determine what type of reaction the animal might have. Table 4-10 presents the criteria for physiological effects from explosives for marine mammals.

Sonic Boom

It is likely that any noise associated with the sonic boom would transmit from the air to water and propagate some distance in the water column. A sonic boom at the surface of 2 psf decayed to approximately 152 dB re 1 µPa at a depth of 7 m (23 ft). By 22 m (72 ft), the received levels were approximately 140 dB re 1 µPa and at 37 m (121 ft), it was equal to ambient noise levels. All of these sound pressure levels are below the current NMFS threshold for potential permanent injury (190 dBrms re 1 µPa sound pressure level for pinnipeds and 180 dBrms re 1 µPa sound pressure level for cetaceans) and potential behavioral change or temporary injury (160 dBrms re 1 µPa sound pressure level). The point at which underwater sound pressure levels would equal or exceed 160dBrms re 1 µPa would likely occur at less than 7 m which could be at or near the surface level of the water based on the decay rate provided above at a depth of 7 m. An ESA-listed marine mammal would only be within the <7 m range for an extremely short time to either breathe or break the surface of the water at the conclusion a feeding event (i.e., humpback whales breaking through the surface of the water after they congregate and feed on their prey). As a result, the sonic boom associated with the contingency landing would be less than an explosion on the drone ship (blast injury and barotrauma is measured following exposure to an explosion) and would be less than what is estimated above at the water's surface generated by the Falcon 9 Full Thrust First Stage during the contingency drone ship landing.

Based on the estimated sound levels, the frequency with which the sonic booms may occur over the course of a year and the relative infrequency with which ESA-listed mammals may be in the immediate vicinity during those times, we conclude that sonic booms associated with

contingency landing actions may affect, but are not likely to adversely affect the ESA-listed marine mammals and would not be significant.

First Stage Explosion

Noise resulting from an unsuccessful drone ship landing (explosion) can introduce loud, impulse, broadband sounds into the ocean or near the water's surface. These sounds can be within the audible range of most marine mammals, but the expected duration is very short. The direct sound from explosions would last less than a second, and most events involve only one explosion. Furthermore, events are dispersed in time, with maximum of six drone ship landing attempts occurring each year. The spacing of the landing attempts would likely reduce the potential for long-term auditory masking. However, because of its intensity, the direct sound from an explosion could cause behavioral or physiological effects to marine mammals.

If an explosion occurs upon the drone ship, as in an unsuccessful drone ship landing, exceptionally little of the acoustic energy from the explosion would transmit into the water (Yagla and Stiegler 2003). An explosion on the drone ship would create a blast in air that propagates away in all directions, including toward the water surface, although the drone ship's deck would act as a barrier that would minimize the amount of energy directed directly downward towards the water (Yagla and Stiegler 2003). As described above, most sound enters the water in a narrow cone beneath the sound source (within 13 degrees [°] of vertical). Since the explosion would occur on the drone ship, most of this sound would be reflected by the drone ship's surface, and sound waves would approach the water's surface at angles higher than 13°, minimizing transmission into the ocean.

An explosion on the drone ship would also send energy through the ship structure, into the water, and away from the ship. This effect was investigated in conjunction with the measurements described in Yagla and Stiegler (2003). The energy transmitted through the ship to the water for the firing of a typical 5-inch round was about 6 percent of that from the air blast impinging on the water. Therefore, sound transmitted from the gun through the hull into the water is a minimal component of overall weapons firing noise, and would be expected to be a minimal component for an explosion occurring on the surface of the drone ship.

Depending on the amount of fuel remaining in the booster at the time of the explosion, the intensity of the explosion would likely vary. As indicated above, the explosive equivalence of the First Stage with maximum fuel and oxidizer is 503 lb. of TNT. Explosion shock theory has proposed specific relationships for the peak pressure and time constant in terms of the charge weight and range from the detonation position. Utilizing these equations, and modifying them for use in the far-field (Continental Shelf Associates, Inc. 2004), the received level at 32.8 ft. (10 m) during a surface water explosion would be approximately 268 dB re 1 μPa. If it is assumed that the drone ship absorbs approximately 94 percent of that energy (Yagla and Stiegler 2003), the received level at a 32.8 ft. (10 m) distance underwater from the drone ship would be 21 dB re 1 μPa. This is far below the threshold levels at which physiological impacts would occur for cetaceans and pinnipeds (Table 4-10).

As a result, an explosion on the drone ship during an unsuccessful drone ship landing attempt generated by the Falcon 9 Full Thrust First Stage during the contingency drone ship landing action

may affect, but is not likely to adversely affect the seven ESA-listed marine mammals: Guadalupe fur seal, blue whale, fin whale, gray whale, humpback whale, sei whale, and sperm whale. Likewise, an explosion on the drone ship during an unsuccessful drone ship landing would not result in Level B harassment or have a significant effect on marine mammals protected under the MMPA.

Landing Noise

The Falcon 9 Full Thrust First Stage will generate landing noise up to 150 dB (well below the ESA and MMPA thresholds) for a short duration (minutes). Should a marine mammal be at the water's surface at the time of the landing, the sound could elicit a response such as an alert, avoidance, or other behavioral reactions such as diving and moving away from the source, but any response is expected to be temporary, if it occurs at all. The landing noise is not expected to have an effect on submerged animals or those that spend a considerable amount of time submerged, such as large whales. Disturbance to landing noise would be unlikely to cause long-term impacts to marine mammals. As a result, landing noise generated by the Falcon 9 Full Thrust First Stage during the contingency landings may affect, but is not likely to adversely marine mammals protected under the ESA and MMPA.

Vessel Noise

Vessel noise has the potential to disturb marine mammals by eliciting an alert, avoidance, or other behavioral reactions such as diving and moving away from the source. Marine mammals in the proposed zone of influence may be exposed to project-related vessels and vessel noise. However, it may be difficult for the animals to discern vessel noise associated with the proposed activities as additional to that which is already present due to research, ecotourism, commercial or private vessels, or government activities. As a result, vessel noise generated by the support vessels required to support the contingency landing actions may affect, but are not likely to adversely affect marine mammals.

Expended Materials and Fluids

Floating Debris

SpaceX has experience performing recovery operations after water and unsuccessful drone ship landings for previous Falcon 9 Full Thrust First Stage landing attempts. This experience, in addition to the debris catalog that identifies all floating debris, has revealed that approximately 25 pieces of debris remain floating after an unsuccessful drone ship landing. The surface area potentially impacted with debris would be less than 114 ac. (0.46 km^2), and the vast majority of debris would be recovered. All other debris sinks to the bottom of the ocean.

These 25 pieces of floating debris are primarily made up of Carbon Over Pressure Vessels (COPVs), the LOX fill line, and carbon fiber constructed landing legs. SpaceX has performed successful recovery of all of these floating items during previous landing attempts. An unsuccessful drone ship landing would result in a very small debris field, making recovery of debris relatively straightforward and efficient. All debris recovered offshore would be transported back to Long Beach Harbor.

Since the area that would be impacted by falling debris is very small, the likelihood of adverse effects to marine mammals is very low. Denser debris that would not float on the surface is anticipated to sink relatively quickly and is composed of inert materials that would not affect water quality or bottom substrate potentially used by marine mammals. The rate of deposition would vary with the type of debris; however, none of the debris is so dense or large that benthic habitat would be degraded. Also, the area that would be impacted by a piece or pieces of sinking debris is only 0.17 ac. (0.000706 km^2), a relatively small portion of the total 114 ac. (0.46 km^2) potential impact area, based on a maximum range of 1,250 ft. (384 m) that a piece of debris would travel following an explosion. As a result, debris from an unsuccessful drone ship landing that enters the ocean environment approximately 31 mi. (50 km) from shore may affect, but is not likely to adversely affect the seven ESA-listed marine mammals: Guadalupe fur seal, blue whale, fin whale, gray whale, humpback whale, sei whale, and sperm whale. Likewise, debris would not have a significant effect on marine mammals protected under the MMPA.

Rocket Propellant

In the event of an unsuccessful landing attempt, the First Stage would explode upon impact with the drone ship. At most, the First Stage would contain 2,750 lb. of rocket propellant (RP-1 or "fuel") on board. In the event of an unsuccessful drone ship landing, most of this fuel would be consumed during the subsequent explosion. Residual fuel would be released into the ocean. Final volumes of fuel remaining in the First Stage upon impact may vary, but are anticipated to be below the high range estimations.

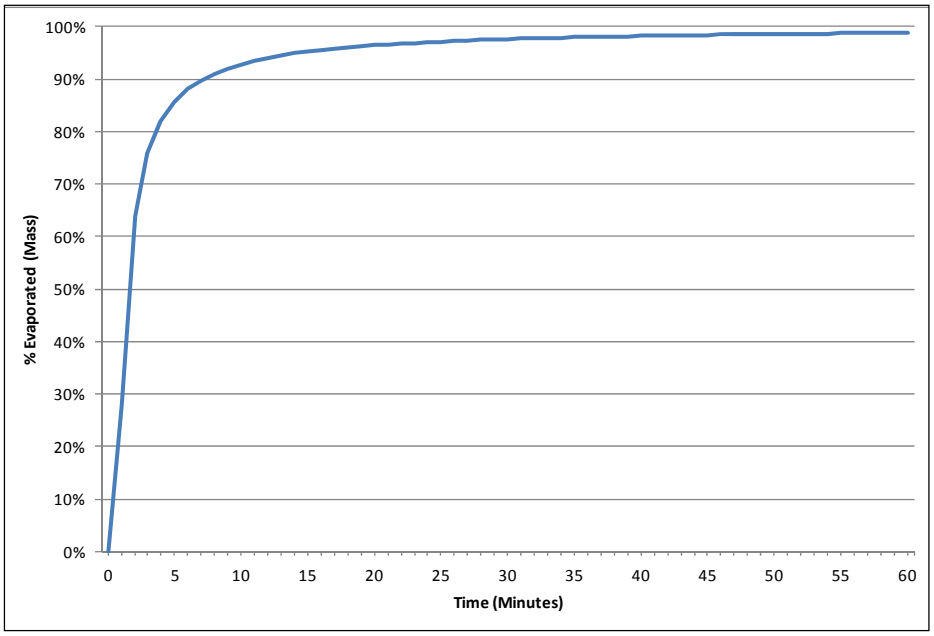
The fuel used by the First Stage, RP-1, is a Type 1 "Very Light Oil", which is characterized as having low viscosity, low specific gravity, and are highly volatile (USFWS 1998). Due to its high volatility, RP-1 evaporates quickly when exposed to the air, and would completely dissipate within one to two days after a spill in the water. Clean-up following a spill of very light oil is usually not necessary or not possible, particularly with such a small quantity of oil that would enter the ocean in the event of an unsuccessful drone ship landing (USFWS 1998). Therefore, no attempt would be made to boom nor recover RP-1 fuel from the ocean.

In relatively high concentrations, exposure to very light oils can cause skin and eye irritation, increased susceptibility to infection, respiratory irritation, gastrointestinal inflammation, ulcers, bleeding, diarrhea, damage to organs, immune suppression, reproductive failure, and death. The effects of exposure primarily depend on the route (internal versus external) and amount (volume and time) of exposure. Although the EPA has established exposure levels for kerosene and jet fuel (RP-1 is a type of kerosene) for toxicity in mammals and the environment (EPA 2011), in reality it is difficult to predict exposure levels, even with a known amount of fuel released. This is because exposure level is dependent not only on the amount of fuel in the spill area, but also on unpredictable factors, including the behavior of the animal and the amount of fuel it contacts, ingests, or inhales.

However, precluding these factors is the overall risk of a marine mammal being within the fuel spill area before the RP-1 dissipates. For the case of RP-1, a Very Light Oil, this risk depends primarily on how quickly RP-1 dissipates in the environment and the area affected by the spill. Since RP-1 is lighter than water and almost completely immiscible (i.e., very little will dissolve into the water column), RP-1 would stay on top of the water surface. Due to its low viscosity, it

would rapidly spread into a very thin layer (several hundred nanometers) on the surface of the water and would continue to spread as a function of sea surface conditions, wind, current, and wave conditions. This spreading rapidly reduces the concentration of RP-1 on the water surface at any one location and exposes more surface area of the fuel to the atmosphere, thus increasing the amount of RP-1 that is able to evaporate.

RP-1 is highly volatile and evaporates rapidly when exposed to the air (USFWS 1998). The evaporation rate for jet fuel (a kerosene similar to RP-1) on water can be determined by the following equation from Fingas (2013): $\%EV = (0.59 + 0.13T)/t$, where $\%EV$ is the percent of mass evaporated within a given time in minutes (t) at a given temperature in °C (T). If we assume an air temperature of 50° F (10° C), the percent of mass evaporated versus time can be determined, as shown in Figure 4-2. Although 1–2 days would be required for the RP-1 to completely dissipate, over 90 percent of its mass would evaporate within the first seven minutes and 99 percent of its mass would evaporate within the first hour (Figure 4-2). In the event of adverse ocean conditions (e.g., large swells, large waves) and weather conditions (e.g., fog, rain, high winds) RP-1 would be volatilized more rapidly due to increased agitation and thus dissipate even more quickly and further reduce the likelihood of exposure.



Fingas 2013

Figure 4-2. Evaporation Rate of Jet A1 fuel (similar to RP-1) as Function of Time (minutes)

Given the relatively small volume of RP-1 that would be spilled (2,750 lb.), the potential exposure area would be small, and thus it is unlikely that a marine mammal would be within the exposure area. Based on the thinness of the layer of RP-1 on the water surface, spreading on the surface (thus rapidly reducing concentration), and rapid evaporation (further reducing concentration), an animal would need to be at the surface within the layer of RP-1 and be exposed to a toxic level within a very short period of time (minutes) after the spill to experience negative effects. Additionally, since the spill would occur concurrent to the explosion of the First Stage, any animals that may have been in the immediate area of the drone ship would likely submerge and

move away from the area due to the disturbance associated with the explosion. Similarly, since RP-1 would be a very thin, rapidly evaporating layer on the water surface, fish and other prey species would not be negatively impacted to any significant degree.

It is therefore highly unlikely that RP-1 spilled as a result of an unsuccessful drone ship landing that enters the ocean environment approximately 31 mi. (50 km) from shore would have an effect on marine mammal species. Therefore, spilled fuel from an unsuccessful drone ship landing that enters the ocean environment approximately 31 mi. (50 km) from shore may affect, but is not likely to adversely affect the seven ESA-listed marine mammals: Guadalupe fur seal, blue whale, fin whale, gray whale, humpback whale, sei whale, and sperm whale. Given the small estimated volume of RP-1 that may be spilled and that it would dissipate quickly, marine mammals protected under the MMPA are highly unlikely to be affected.

Table 4-11. Potential Impacts to Marine Mammal Species Potentially Occurring within the Contingency Area

Species	Status	Potential Impacts
Pinnipeds		
Pacific Harbor Seal *Phoca vitulina richardsi*	MMPA	Nearshore - disturbance from in-air noise, vibration, & light, Offshore – Disturbance from debris, underwater noise, & expended materials.
California Sea Lion *Zalophus californianus*	MMPA	Nearshore - disturbance from in-air noise, & light, Offshore – Disturbance from debris, underwater noise, & expended materials.
Northern Elephant Seal *Mirounga angustirostris*	MMPA	Nearshore - disturbance from in-air noise, & light, Offshore – Disturbance from debris, underwater noise, & expended materials.
Steller Sea Lion *Eumetopias jubatus*	FD	Nearshore - disturbance from in-air noise, & light, Offshore – Disturbance from debris, underwater noise, & expended materials.
Northern Fur Seal *Callorhinus ursinus*	MMPA	Nearshore - disturbance from in-air noise, & light, Offshore – Disturbance from debris, underwater noise, & expended materials.
Guadalupe Fur Seal *Arctocephalus townsendi*	FT	Nearshore - disturbance from in-air noise, & light, Offshore – Disturbance from debris, underwater noise, & expended materials.
Cetaceans		
Humpback whale *Megaptera novaeangliae*	FE	Disturbance from debris, underwater noise, & expended materials.
Blue whale *Balaenoptera musculus*	FE	Disturbance from debris, underwater noise, & expended materials.
Fin whale *Balaenoptera physalus*	FE	Disturbance from debris, underwater noise, & expended materials.
Sei whale *Balaenoptera borealis*	FE	Disturbance from debris, underwater noise, & expended materials.
Bryde's whale *Balaenoptera brydei/edeni*	MMPA	Disturbance from debris, underwater noise, & expended materials.

Species	Status	Potential Impacts
Minke whale *Balaenoptera acutorostrata*	NL	Disturbance from debris, underwater noise, & expended materials.
Gray whales *Eschrichtius robustus*	FE/NL[4]	Disturbance from debris, underwater noise, & expended materials.
Sperm whale *Physeter microcephalus*	FE	Disturbance from debris, underwater noise, & expended materials.
Pygmy sperm whale *Kogia breviceps*	MMPA	Disturbance from debris, underwater noise, & expended materials.
Dwarf sperm whale *Kogia sima*	MMPA	Disturbance from debris, underwater noise, & expended materials.
Killer whale *Orcinus orca*	MMPA	Disturbance from debris, underwater noise, & expended materials.
Short-finned pilot whales *Globicephala macrorhynchus*	MMPA	Disturbance from debris, underwater noise, & expended materials.
Long-beaked common dolphins *Delphinus capensis*	MMPA	Disturbance from debris, underwater noise, & expended materials.
Short-beaked common dolphins *Delphinus delphis*	MMPA	Disturbance from debris, underwater noise, & expended materials.
Common bottlenose dolphin *Tursiops truncates*	MMPA	Disturbance from debris, underwater noise, & expended materials.
Striped dolphin *Stenella coeruleoalba*	MMPA	Disturbance from debris, underwater noise, & expended materials.
Rough-toothed dolphin *Steno bredanensis*	MMPA	Disturbance from debris, underwater noise, & expended materials.
Pacific white-sided dolphin *Lagenorhynchus obliquidens*	MMPA	Disturbance from debris, underwater noise, & expended materials.
Northern right whale dolphin *Lissodelphis borealis*	MMPA	Disturbance from debris, underwater noise, & expended materials.
Risso's dolphin *Grampus griseus*	MMPA	Disturbance from debris, underwater noise, & expended materials.
Dall's Porpoise *Phocoenoides dalli*	MMPA	Disturbance from debris, underwater noise, & expended materials.
Cuvier's beaked whale *Ziphius cavirostris*	MMPA	Disturbance from debris, underwater noise, & expended materials.
Baird's beaked whale *Berardius bairdii*	MMPA	Disturbance from debris, underwater noise, & expended materials.
Blainville's beaked whale *Mesoplodon densirostris*	MMPA	Disturbance from debris, underwater noise, & expended materials.
Ginkgo-toothed beaked whale *Mesoplodon ginkgodens*	MMPA	Disturbance from debris, underwater noise, & expended materials.
Perrin's beaked whale *Mesoplodon perrini*	MMPA	Disturbance from debris, underwater noise, & expended materials.
Stejneger's beaked whale *Mesoplodon stejnegeri*	MMPA	Disturbance from debris, underwater noise, & expended materials.
Hubbs' beaked whale *Mesoplodon carlhubbsi*	MMPA	Disturbance from debris, underwater noise, & expended materials.

Species	Status	Potential Impacts
Pygmy beaked whale *Mesoplodon peruvianus*	MMPA	Disturbance from debris, underwater noise, & expended materials.

Notes: FE = Federal Endangered Species, FT = Federal Threatened Species, FC = Federal Candidate Species, BCC = Federal Bird Species of Conservation Concern, BGEPA = Bald and Golden Eagle Protection Act, SE = State Endangered Species, CSC = California Species of Special Concern, SC = State Candidate Species, FP = California Fully Protected Species, SOC = Species of Concern

4.3.1.5 Offshore Special Status Species (Non-Mammal)

Offshore protected species in addition to marine mammals considered under this EA include sea turtles and ESA-listed fish species. Analyses of impacts to these species are based on the Alternative 1 analysis of potential debris impacts to marine mammals presented above.

4.3.1.5.1 Sea Turtles

Debris Strike

The probability of impact of debris with a sea turtle was estimated using the same approach as presented above for marine mammals; however, we were limited by the lack of density data for green sea turtle, loggerhead sea turtle, olive ridley sea turtle, and hawksbill sea turtle. These four species are considered rare in the Pacific Ocean offshore of Central California so the probability of impact would be less than the much more commonly observed leatherback sea turtle. Using the debris impact analysis presented above (U.S. Department of the Navy 2014b), the estimated probability of debris strike as a result of explosion of the First Stage with an individual leatherback sea turtle is 0.0003 and the annual estimated number of takes would be 0.0019 (Table 4-13). A conservative probability of debris strike with individual green sea turtle, loggerhead sea turtle, olive ridley sea turtle, or hawksbill turtle would be less than 0.0003, and annual estimated takes for these two species less than 0.0019 (Table 4-13). In addition, sea turtles spend a significant amount of time at depth while off shore; thus, these estimates are conservative since they assume the animals are at the surface at all times.

Table 4-12. Estimated At-Sea Density of Individuals per km^2, Probability of Direct Impact of Rocket Debris per Event, and Estimated Number of Takes

Species	Estimated At-Sea Density (km^2)	Probability of Impact per Event (*T*)	Estimated Number of Impacts per year^
Green Sea Turtle	< 0.035	< 0.0003	< 0.0019
Loggerhead Sea Turtle	< 0.035	< 0.0003	< 0.0019
Olive Ridley Sea Turtle	< 0.035	< 0.0003	< 0.0019
Hawksbill Sea Turtle	< 0.035	< 0.0003	< 0.0019
Leatherback Sea Turtle	0.035*	0.0003	0.0019

* U.S. Department of the Navy 2014a.

^ Based on up to six events per year.

Note: km^2 = square kilometer(s)

These probabilities are sufficiently low to reasonably conclude that it would be unlikely the any of the three ESA-listed sea turtles would be struck by debris as a result of conducting up to six contingency landings per year that result in explosion of the Falcon 9 Full Thrust First Stage. As a result, the potential debris strike as a result of First Stage explosion may affect, but is not likely to adversely affect the five ESA-listed sea turtles: green sea turtle, loggerhead sea turtle, olive Ridley sea turtle, hawksbill sea turtle, and leatherback sea turtle.

Underwater Acoustic Impacts

Acoustic impacts criteria and thresholds have been developed for sea turtle exposures to various sound sources (U.S. Department of the Navy 2012). These acoustic impacts criteria for impulsive sources are summarized in Table 4-14.

Table 4-13. Sea Turtle Impact Threshold Criteria for Impulsive Sources

Impulsive Sound Exposure Impact	Threshold Value
Onset Mortality[1] (1% Mortality Based on Extensive Lung Injury)	$= 91.4M^{1/3}\left(1+\frac{D_{Rm}}{10.081}\right)^{1/2} Pa-s$
Onset Slight Lung Injury[1]	$= 39.1M^{1/3}\left(1+\frac{D_{Rm}}{10.081}\right)^{1/2} Pa-s$
Onset Slight Gastrointestinal Tract Injury	237 dB re 1 μPa SPL (104 psi)
Onset PTS	230 dB re 1 μPa Peak SPL
Onset TTS	224 dB re 1 μPa Peak SPL

[1] M = mass of animals (kg) as shown for each species, D_{Rm} = depth of animal (m). Impulse calculated over a delivery time that is the lesser of the initial positive pressure duration or 20 percent of the natural period of the assumed-spherical lung adjusted for animal size and depth.

[2] Turtle Weighting Function. When the cetacean criteria were weighted to correlate with Type II frequency weighting, the turtle threshold was inadvertently lowered by 17 dB, even though Type II weighting is not applied to sea turtle hearing. This resulted in an increased number of model-predicted turtle impacts, although the actual impacts are expected to be substantially lower.

[3] The interval for determining the root mean square is that which contains 90% of the total energy within the envelope of the pulse. This windowing procedure for impulse signals removes uncertainty about where to set the exact temporal beginning or end of the signal, which may be obscured by ambient noise.

Notes: dB re 1 μPa = decibel(s) referenced to 1 micropascal(s), m = meter(s), psi = pound(s) per square inch, PTS = permanent threshold shift, TTS = temporary threshold shift, SEL = sound exposure level, SPL = sound pressure level

Sonic Boom

A sonic boom of 2 psf at the surface, as anticipated from Falcon 9 Full Thrust First Stage boost-back, is expected to decay to approximately 152 dB re 1 μPa at a depth of 23.0 ft. (7 m). By 72.2 ft. (22 m), the received level was approximately 140 dB re 1 μPa and by 121.4 ft. (37 m), the acoustic wave would be subsumed by ambient noise levels. All of these levels are below the

peak SPL criteria for physiological effects from acoustics on sea turtles. As a result, the sonic boom generated by the Falcon 9 Full Thrust First Stage during the contingency landing actions may affect, but is not likely to adversely affect the five ESA-listed sea turtles: green sea turtle, loggerhead sea turtle, olive Ridley sea turtle, hawksbill sea turtle, and leatherback sea turtle.

First Stage Explosion

The approach to analyzing impacts from the explosion of the Falcon 9 Full Thrust First Stage near the water is the same as presented for marine mammals above. Onset TTS and PTS SPL values are the same for cetaceans and sea turtles. Therefore, a sea turtle would not experience physiological impacts as a result of the explosion of the First Stage during an unsuccessful drone ship landing, since the drone ship would reflect and absorb approximately 94 percent of the energy from the blast (Yagla and Steigler 2003).

As a result, explosion of the Falcon 9 Full Thrust First Stage on the drone ship the contingency landing action may affect, but is not likely to adversely affect the five ESA-listed sea turtles: green sea turtle, loggerhead sea turtle, olive Ridley sea turtle, hawksbill sea turtle, and leatherback sea turtle.

Landing Noise

The Falcon 9 Full Thrust First Stage would generate landing noise up to 110 dB. This landing noise event would be of short duration (minutes). Landing noise would likely disturb sea turtles at the water surface and elicit an alerting, avoidance, or other short term behavioral reactions, including diving and potentially moving away from the source of the noise. In addition, sea turtle species spend most of the time underwater and exceptionally little sound is transmitted between the air-water interface (Godin 2008); thus, in-air sound would not have a significant effect on submerged sea turtles. Disturbance due to landing noise would be unlikely to cause long-term consequences for individuals or populations of sea turtles. As a result, landing noise generated by the Falcon 9 Full Thrust First Stage during the contingency landing actions may affect, but is not likely to adversely affect the five ESA-listed sea turtles: green sea turtle, loggerhead sea turtle, olive Ridley sea turtle, hawksbill sea turtle, and leatherback sea turtle.

Vessel Noise

Vessel noise has the potential to disturb sea turtles and elicit an alerting, avoidance, or other behavioral reaction. As a result, vessel noise generated by the Falcon 9 Full Thrust First Stage during the contingency landing actions may affect, but is not likely to adversely affect the five ESA-listed sea turtles: green sea turtle, loggerhead sea turtle, olive Ridley sea turtle, hawksbill sea turtle, and leatherback sea turtle.

Expended Materials and Fluids

Debris

As described above, SpaceX would remove the approximately 25 pieces of debris that are expected to remain floating after an unsuccessful drone ship landing. Denser debris that would not float on the surface is anticipated to sink relatively quickly and is composed of inert materials,

which would not affect water quality or bottom substrate. The rate of deposition would vary with the type of debris; however, none of the debris is so dense or large that benthic habitat would be degraded. Since the area that would be impacted by sinking debris is very small 0.17 ac. (0.000706 km^2) the likelihood of adverse effects to ESA-listed sea turtles is very low. As a result, debris from an unsuccessful drone ship landing that enters the ocean environment approximately 31 mi. (50 km) from shore may affect, but is not likely to adversely affect the five ESA-listed sea turtles: green sea turtle, loggerhead sea turtle, olive Ridley sea turtle, hawksbill sea turtle, and leatherback sea turtle.

Rocket Propellant

As described above, a maximum of 2,750 lb. of RP-1 would be released into the ocean as a result of an unsuccessful drone ship landing. RP-1 is a very light oil, which is highly volatile and would evaporate quickly (90 percent within first 7 minutes; 99 percent within first hour; Figure 4-2) when exposed to the air and would completely dissipate within one to two days after a spill in the water. In the event of adverse ocean conditions (e.g., large swells, large waves) and weather conditions (e.g., fog, rain, high winds) RP-1 would be volatilized more rapidly due to increased agitation and thus dissipate even more quickly. Since the amount of spilled fuel would be small and would dissipate quickly, spilled fuel from an unsuccessful drone ship landing that enters the ocean environment approximately 31 mi. (50 km) from shore may affect, but is not likely to adversely affect the six ESA-listed sea turtles: green sea turtle, loggerhead sea turtle, olive Ridley sea turtle, hawksbill sea turtle, and leatherback sea turtle.

4.3.1.5.2 Special Status Fish Species

Debris Strike

Sufficient density data are not available to conduct a debris strike analysis in the manner conducted above. Steelhead, if present in the area of potential debris impacts, would be less likely to be at or near the water surface where debris could strike them than marine mammals or sea turtles. Scalloped hammerhead sharks, although occasionally at the water surface, tend to be found where water temperatures are at least 22°C (72°F) (Castro 1983; Compagno 1984). Water temperatures in the region of the contingency landing location are typically below 18°C (64°F); therefore, scalloped hammerhead sharks would be rare. Both species, therefore, would be expected to have lower effective densities than the marine mammals and sea turtles discussed above and the probability that an individual of either species would potentially be impacted by debris is discountable. As a result, potential debris strike as a result of First Stage explosion may affect, but is unlikely to adversely affect the ESA-listed fish species: steelhead trout and scalloped hammerhead shark. The basking shark is occasionally observed at the surface of the water, is expected to be in low densities and would be unlikely to be impacted. The cowcod is not observed at the surface and would not be affected by debris strike. Therefore, there would be no significant impacts to special status fish species as a result of debris strike during an unsuccessful drone ship landing.

Underwater Acoustic Impacts

For fish, the greatest potential for direct, non-auditory tissue effects is primary blast injury and barotrauma following exposure to explosions. Primary blast injury refers to those injuries that result from the initial compression of a body exposed to a blast wave. Primary blast injury is usually limited to gas-containing structures (e.g., swim bladder) and the auditory system, although, with increased proximity, even non-gas filled structures could be damaged. Barotrauma refers to injuries caused when the swim bladder or other gas-filled structures vibrate in response to the signal, particularly if there is a relatively sharp rise-time and the walls of the structure strike near-by tissues and damage them.

The potential fish mortality associated with the use of at-sea explosives led military researchers to develop mathematical and computer models that predict safe ranges for fish from explosions of various sizes. Young (1991) provides equations that allow estimation of the potential effect of underwater explosions on fish possessing swim bladders using a damage prediction method developed by Goertner (1982). Table 4-15 lists estimated explosive effects ranges using Young's (1991) method for fish possessing swim bladders exposed to explosions 3.3 ft. (1 m) below the water surface from a 503 lb. explosion.

Table 4-14. Estimated Explosive Effects Ranges for Fish with Swim Bladders

Net Explosive Weight (lb.)	10% Mortality Range (m)		
	1 oz. Fish	1 lb. Fish	30 lb. Fish
503	308	215	138

Notes: lb. = pound(s), oz. = ounce(s)

Sonic Boom

A sonic boom of 2 psf at the surface, as anticipated from the Falcon 9 Full Thrust First Stage boost-back, is expected to decay to approximately 152 dB re 1 μPa at a depth of 23.0 ft. (7 m). By 72.2 ft. (22 m), the received level was approximately 140 dB re 1 μPa and by 121.4 ft. (37 m), the acoustic wave would be subsumed by ambient noise levels. Stadler and Woodbury (2009) established that the onset of physical injury to fish would be expected if the peak SPL exceeds 206 dB re 1 μPa. The anticipated received sound levels from a sonic boom are below these criteria for physiological effects to fish. As a result, the sonic boom generated by the Falcon 9 Full Thrust First Stage during the contingency landing action may affect, but is not likely to adversely affect ESA-listed fish species: steelhead and scalloped hammerhead shark. By the same reasoning, underwater noise generated by the sonic boom would not have a significant effect on special status fish species.

First Stage Explosion

As discussed above, the drone ship would absorb approximately 94 percent of the energy resulting from an explosion of the First Stage during an unsuccessful drone ship landing. The resulting pressure level that is transmitted through the drone ship would not be great enough to cause physiological impacts to fish. As a result, explosion at or near the water surface generated by the Falcon 9 Full Thrust First Stage during the contingency drone ship landing action may

affect, but is not likely to adversely affect ESA-listed fish species: steelhead trout, green sturgeon and scalloped hammerhead shark and would not be significant.

Landing Noise

The Falcon 9 Full Thrust First Stage would generate landing noise up to 110 dB. This landing noise event would be of short duration (minutes) and exceptionally little sound is transmitted between the air-water interface (Godin 2008). Fish at or near the surface of the water would potentially experience behavioral disruption, but the sound levels transmitted into the water would be far below injury levels. Thus, in-air sound would not have a significant effect on ESA-listed fish species, which are submerged. As a result, landing noise generated by the Falcon 9 Full Thrust First Stage during the contingency landing action may affect, but is not likely to adversely affect ESA-listed fish species: steelhead trout, green sturgeon and scalloped hammerhead shark. Similarly, underwater noise generated by landing noise is not expected to have a significant impact on special status fish species.

Vessel Noise

Vessel noise has the potential to create in-water sound that could disturb ESA-listed fish species, which could result in short-term behavioral (e.g., avoidance) or physiological responses (e.g., stress, increased heart rate). While vessel movements have the potential to expose ESA-listed fish species occupying the water column to noise and general disturbance, potentially resulting in short term behavioral or physiological responses, such responses would not be expected to compromise the general health or condition of individual fish, since fish can move away from the disturbance. Therefore, impacts from vessel noise would be temporary, infrequent, and localized and long-term consequences for individuals or the population are not expected. As a result, vessel noise in support of the Falcon 9 Full Thrust First Stage during the contingency landing action may affect, but is not likely to adversely affect ESA-listed fish species: steelhead trout, green sturgeon and scalloped hammerhead shark. Similarly, vessel noise is not expected to have a significant impact on special status fish species.

Expended Materials

Debris

As described above, SpaceX would remove the approximately 25 pieces of debris that are expected to remain floating after an unsuccessful drone ship landing. Denser debris that would not float on the surface is anticipated to sink relatively quickly and is composed of inert materials that would not affect water quality or bottom substrate. The rate of deposition would vary with the type of debris; however, none of the debris is so dense or large that benthic habitat would be degraded. Since the area that would be impacted by sinking debris is very small (0.17 ac. [0.000706 km^2]), the likelihood of adverse effects to special status fish species is very low. As a result, debris from an unsuccessful drone ship landing that enters the ocean environment approximately 31 mi. (50 km) from shore may affect, but is not likely to adversely affect ESA-listed fish species: steelhead trout, green sturgeon and scalloped hammerhead shark. Similarly, debris is not expected to have a significant impact on special status fish species.

Rocket Propellant

The maximum of 2,750 lb. of RP-1 that would be released into the ocean as a result of an unsuccessful drone ship landing. RP-1 is a very light oil, which is highly volatile and would evaporate quickly (90 percent within first seven minutes; 99 percent within first hour; Figure 4-2) when exposed to the air and would completely dissipate within one to two days after a spill in the water. In the event of adverse ocean conditions (e.g., large swells, large waves) and weather conditions (e.g., fog, rain, high winds) RP-1 would be volatilized more rapidly due to increased agitation and thus dissipate even more quickly. In addition, the ESA-listed fish species, steelhead and scalloped hammerhead shark, are typically below the surface and would not be expected to interact with surface of the water frequently, making them unlikely to be exposed to RP-1 on the ocean surface. As discussed above, the probability of steelhead and scalloped hammerhead sharks being present at contingency landing location during a landing event would be very low, thus reducing likelihood of exposure even greater. As a result, spilled fuel from an unsuccessful drone ship landing that enters the ocean environment approximately 31 mi. (50 km) from shore may affect, but is not likely to adversely affect the ESA-listed fish species: steelhead trout, green sturgeon and scalloped hammerhead shark. Similarly, release of RP-1 is not expected to have a significant impact on other special status fish species.

Table 4-15. Potential Impacts to Special Status Non-Mammal Species Potentially Occurring within the Contingency Area

Species	Status	Potential Impacts
Fish		
Steelhead trout *Oncorhynchus mykiss*	FE	Disturbance from debris, noise, vibration, & expended materials.
Green sturgeon Acipenser medirostris	FT	Disturbance from debris, noise, vibration, & expended materials.
Scalloped Hammerhead Shark *Sphyrna lewini*	FE	Disturbance from debris, noise, vibration, & expended materials.
Basking shark *Cetorhinus maximus*	SOC	Disturbance from debris, noise, vibration, & expended materials.
Bocaccio *Sebastes paucispinis*	SOC	Disturbance from debris, noise, vibration, & expended materials.
Cowcod *Sebastes levis*	SOC	Disturbance from debris, noise, vibration, & expended materials.
Reptiles		
Green sea turtle *Chelonia mydas*	FT/FE	Disturbance from debris, noise, vibration, & expended materials.
Hawksbill sea turtle *Eretmochelys imbricata*	FE	Disturbance from debris, noise, vibration, & expended materials.
Loggerhead sea turtle *Caretta*	FE	Disturbance from debris, noise, vibration, & expended materials.

Species	Status	Potential Impacts
Olive ridley sea turtle *Lepidochelys olivacea*	FT/FE	Disturbance from debris, noise, vibration, & expended materials.
Leatherback sea turtle *Dermochelys coriacea*	FE	Disturbance from debris, noise, vibration, & expended materials.

Notes: FE = Federal Endangered Species, FT = Federal Threatened Species, FC = Federal Candidate Species, SOC = Species of Concern

4.3.1.6 Sensitive Marine Habitats

4.3.1.6.1 Essential Fish Habitat

An unsuccessful drone ship landing of the Falcon 9 Full Thrust First Stage may include the discharge of fuel. Adverse effects to EFH species and their prey associated with petroleum-based contaminants can range from acute toxicity at high levels of exposure to chronic sub-lethal toxicity. However, the first stage booster uses RP-1, characterized as a "Very Light Oil" that has a low viscosity, low specific gravity and is highly volatile. In addition, the anticipated amount of residual fuel during an unsuccessful landing attempt would be limited (i.e., 50–150 gallons) and would most likely be released onto the drone ship deck upon impact. In the event the first stage booster misses the drone ship entirely and the fuel is released into the ocean, the RP-1 would be expected to evaporate quickly and would completely dissipate within one to two days after a spill. Clean-up of very light oil spills are usually not possible, especially with such small quantities. Given the small quantity and composition of the fuel that may be released, any adverse impacts to EFH would be minimal.

An unsuccessful drone ship landing would result in a projectile range of up to 1,250 feet and the actual surface area potentially impacted with debris would be less than 114 ac. (0.46 km^2). Since the area that would be impacted by falling debris is relatively very small, the likelihood of large-scale impacts to the groundfish and pelagic species EFH is very low. A direct strike to a federally managed fish species from debris, though not impossible, is highly unlikely given the relatively small impact area and amount of debris.

The contingency landing area is approximately 31 mi. (50 km) offshore from the nearest kelp beds and estuary habitat (Figure 3-11) and any floating debris would be retrieved. As a result, there would be no impact to these HAPCs. Debris that would sink is anticipated to sink relatively quickly and is composed of inert materials. The potential area of impact from sinking debris consists primarily of sandy substrate, which is not identified as a particularly sensitive habitat for federally managed fish species. However, there are a number of species managed under the Pacific Coast Groundfish Fishery Management Plan that utilize offshore unconsolidated benthic habitats for at least part of their life cycle (e.g., various rockfish, flatfish, and sharks/skates) for functions such as foraging or refuge. Introducing foreign material could reduce the functionality of those habitats. Marine debris, which can consist of a wide variety of manmade materials, is a growing concern due to the increasing number of species for which negative interactions with debris have been demonstrated (Smith and Edgar 2014). In addition, debris may settle in areas

off the west coast that already have high concentrations, such as deep water habitat and waters south of 36° N (Keller et al. 2010). Although the debris associated with the Proposed Action is inert, it could still result in adverse impacts. For instance, marine debris could be ingested by or entangle marine organisms and alter the benthic invertebrate community (Katsanevakis et al. 2007). Marine debris can also become snagged on or damage sensitive habitats.

NOAA Fisheries concluded that, although one unsuccessful drone ship landing would not contribute substantially to marine debris, the Contingency Action could have an adverse effect on EFH for various federally managed fish species within the Pacific Coast Groundfish, Coastal Pelagic Species, and Highly Migratory Species Fisheries Management Plans as a result of the cumulative addition of marine debris to the seafloor after a number of unsuccessful landing attempts (Appendix E). Therefore, pursuant to section 305(b)(4)(A) of the Magnuson-Stevens Fishery Conservation and Management Act, NOAA Fisheries recommended VAFB develop an appropriate compensatory mitigation plan to avoid, minimize, mitigate, or otherwise offset the adverse effects to EFH. The USAF is developing an appropriate compensatory marine debris removal plan in coordination with NOAA Fisheries to offset these impacts. This plan involves the contribution to a marine debris removal program in the region.

4.3.1.6.2 Critical Habitat – Leatherback Sea Turtle

The contingency landing location of Alternative 1 is approximately 6.2 mi. (10 km) south of this Critical Habitat (Figure 3-12). The area of potential impact in the event of an explosion of the Falcon 9 Full Thrust First Stage is relatively small (114 ac. [0.46 km^2]) and would not reach into Critical Habitat. The Contingency Action is not anticipated to have any measurable impact on jellyfish, the primary food source for leatherback sea turtles. Since leatherback sea turtles do not breed or nest within the project area, Alternative 1 would have no impacts to breeding or nesting habitat for this species.

4.3.1.6.3 Marine Reserves

Channel Islands National Marine Sanctuary

The prohibitions of the CINMS do not apply to military activities carried out by the DoD, as of the effective date of the revised regulations and specifically identified in Section 3.5.9 of the CINMS Final Environmental Impact Statement (EIS), entitled “Department of Defense Activities” ("pre-existing activities") as indicated in Section 922.72(b)(1). Section 3.5.9.1 (VAFB) of the CINMS Final EIS describes spacelift operations originating from VAFB and potential sonic booms from these activities as “pre-existing activities” (NOAA Fisheries 2007). In addition, impacts to the CINMS would be temporary and we anticipate no significant impacts.

Vandenberg State Marine Reserve

A Memorandum of Understanding was established between the CDFW and VAFB. Within the VSMR, no take of living marine resources is permitted except take incidental to the mission critical activities of VAFB. Mission critical activities include, but are not limited to, all those activities that are important for the support and defense of U.S. launch, range, expeditionary, exercise, test, training and installation operations, including, but not limited to, space-launch

vehicles. Impacts to marine resources within the VSMR would be limited to landing noise and sonic boom, which would be temporary. Therefore, we anticipate no significant impacts to the VSMR.

4.3.2 Alternative 2

Under Alternative 2, the landing pad at SLC-4W would not be constructed and landing would not occur at SLC-4W. Landing the Falcon 9 on a drone ship located approximately 320 mi. (515 km) offshore in the Pacific Ocean would have no impact to terrestrial biological resources since the boost-back trajectory, sonic boom, and landing noise would not impact land. In addition, since the landing location is 320 mi. (515 km) offshore, there would be no impact to EFH or Critical Habitat, since none exists in the area. The sonic boom and landing noise would also be sufficiently offshore so that there would be no impacts to marine reserves. As detailed in the Alternative 1 analysis for the offshore landing contingency options, there would not be significant impacts to marine mammals, sea turtles, sea birds, or ESA-listed fish species in the event of an unsuccessful drone ship landing attempt.

4.3.3 No Action Alternative

Under the No Action Alternative, no construction or alteration at SLC-4W would occur. Therefore, we expect no additional impacts to biological resources under the No Action Alternative.

4.4 Water Resources

Impacts to jurisdictional Waters of the U.S. and wetlands are considered significant if the project would result in a net loss of wetland area or habitat value, either through direct or indirect impacts to wetland vegetation, loss of habitat for wildlife, degradation of water quality, or alterations in hydrological function.

4.4.1 Alternative 1 (Proposed Action)

4.4.1.1 Surface Water

Surface water resources in the vicinity of SLC-4W include Spring Canyon Creek and the Pacific Ocean. Construction of the landing pad under the Proposed Action would remove vegetation, expose soils, and has the potential for releases of hazardous materials and wastes because work with heavy machinery is being conducted in the vicinity of Spring Canyon Creek and the Pacific Ocean; therefore, surface water may be potentially impacted without proper implementation of adequate EPMs. A v-ditch surrounding the pad would convey storm water to an existing infiltration basin designed to meet the NPDES Construction General Permit, Post Construction Storm Water Standards or Energy Independence and Security Act of 2007 Section 438. Wastewater from a potential spill or firefighting measures would be contained and disposed of per the NPDES Industrial General Permit and would not enter the infiltration basin. The proper management of materials and wastes (as described in Sections 4.8, Hazardous Materials and Waste Management, and 4.9, Solid Waste Management, of this EA) would reduce or eliminate the potential for contaminated runoff. EPMs that would be implemented per the NPDES Construction General Permit are described in detail the Section 2.2.4.12 (Water Resources) and

EPMs described under Section 2.3.4.8 (Geology and Earth Resources) would help protect surface water resources. These EPMs include BMPs designed to properly manage materials while on-site, especially during the rainy season, prevent and reduce the risk of spills, and minimize the potential for erosion.

In the event of an explosion of the Falcon 9 Full Thrust First Stage resulting from an unsuccessful drone ship landing, surface water quality may be affected by expended materials. However, SpaceX would recover all floating pieces of debris. Denser debris that would not float on the surface is anticipated to sink relatively quickly and is composed of inert materials that would not affect water quality. In the event of an unsuccessful drone ship landing, between 50 and 150 gallons of residual RP-1 may be released into the ocean. RP-1, is a Type 1 "Very Light Oil", which is characterized as having low viscosity, low specific gravity, and highly volatile (USFWS 1998). Due to its high volatility, RP-1 evaporates quickly when exposed to the air, and would completely dissipate within one to two days after a spill in the water. Clean-up following a spill of very light oil is usually not necessary or not possible, particularly with such a small quantity of oil that would enter the ocean in the event of an unsuccessful drone ship landing (USFWS 1998). Therefore, no attempt would be made to boom nor recover RP-1 fuel from the ocean. Since RP-1 is lighter than water and almost completely immiscible (i.e., very little will dissolve into the water column), RP-1 would stay on top of the water surface. Due to its low viscosity, it would rapidly spread into a very thin layer (several hundred nanometers) on the surface of water and would continue to spread as a function of sea surface, wind, current, and wave conditions. This spreading rapidly reduces the concentration of RP-1 on the water surface at any one location and exposes more surface area of the fuel to the atmosphere, thus increasing the amount of RP-1 that is able to evaporate. Although it would require one to two days for the RP-1 to completely dissipate, over 90% of its mass would evaporate within the first seven minutes and 99% of its mass would evaporate within the first hour (see Section 4.3.1.4.3, Contingency Drone Ship Landing, Expended Materials and Fluids). In the event of adverse ocean conditions (e.g., large swells, large waves) and weather conditions (e.g., fog, rain, high winds) RP-1 would be volatilized more rapidly due to increased agitation and thus dissipate even more quickly and further reduce the likelihood of exposure.

Therefore, we anticipate no significant impacts to surface water resulting from the Proposed Action.

4.4.1.2 Groundwater

SLC-4W is located on the southern margin of the Santa Ynez River groundwater basin/Lompoc Terrace sub-basin. Groundwater at the site is unconfined and restricted to the unconsolidated material immediately above Sisquoc Formation bedrock. As noted in Section 3.4.3 (Groundwater), groundwater is typically found approximately 50–140 ft. below ground surface. Construction of the landing pad at SLC-4W would not require footings or foundations at this depth, therefore direct interaction with groundwater is unlikely. In addition, proper management of materials and wastes (as described in Sections 4.8, Hazardous Materials and Waste Management, and 4.9, Solid Waste Management, of this EA) would reduce or eliminate the potential for contaminated runoff that could infiltrate groundwater. EPMs that would be implemented per the NPDES Construction General Permit and those described under Section

2.3.4.8 (Geology and Earth Resources) would further help protect groundwater resources. Therefore, we anticipate no significant impacts to groundwater resulting from the Proposed Action.

4.4.1.3 Wetlands and Waters of the United States

There are no jurisdictional Waters of the U.S. or wetlands within the area subject to physical impacts under the Proposed Action. The nearest wetland habitat to SLC-4W is Spring Canyon Creek, approximately 0.08 mi. (0.13 km) to the south of SLC-4W. This habitat has not been delineated. The proper management of materials and wastes (as described in Sections 4.8 Hazardous Materials and Waste Management, and 4.9, Solid Waste Management, of this EA) would reduce or eliminate the potential for contaminated runoff into nearby Waters of the U.S. and Wetlands. EPMs that would be implemented per the NPDES Construction General Permit and are described in detail the Section 2.3.4.12 (Water Resources) and EPMs described under Section 2.3.4.8 (Geology and Earth Resources) would help protect these resources. These EPMs include BMPs designed to properly manage materials while on-site, especially during the rainy season, prevent and reduce the risk of spills, and minimize the potential for erosion. The contingency landing location is 31 mi. (50 km) offshore of VAFB, outside of the boundary for territorial seas (Waters of the U.S.), which only extend 13.8 mi. (22.2 km) offshore. Therefore, the Proposed Action and Contingency Action would have no effect on Waters of the U.S or jurisdictional wetlands.

4.4.2 Alternative 2

Under the Alternative Action, the concrete landing pad at SLC-4W would not be constructed and the Falcon 9 Full Thrust First Stage would land on a drone ship situated approximately 320 mi. (515 km) offshore, outside of territorial seas (Waters of the U.S.), which only extend 13.8 mi. (22.2 km) from the coast. Therefore, Alternative 2 would have no effect on surface waters, groundwater, Waters of the U.S., or wetlands since the location would be over the ocean and beyond the jurisdictional boundary for Waters of the U.S. and wetlands considerations are not applicable at sea.

4.4.3 No Action Alternative

Under the No-Action Alternative, the concrete landing pad and SLC-4W would not be constructed and the boost-back and landing of the Falcon 9 Full Thrust First Stage would not occur. Therefore, the No Action Alternative would have no additional impacts on surface water, groundwater, Waters of the U.S., or wetlands.

4.5 Cultural Resources

Factors considered in determining whether implementing an alternative may result in significant adverse impacts on cultural resources include the extent or degree to which implementation of an alternative would result in:

- The permanent loss of a significant cultural resource or the loss of a value or characteristic that qualify a historic resource for listing on the NRHP; or

- Substantially alter the natural environment or access to it in such a way that traditional cultural or religious activities were restricted.

Effects to cultural resources would be considered adverse if they resulted in disturbance or loss of value or data that qualify a site for listing in the NRHP; if there is substantial disturbance or loss of data from newly discovered properties or features prior to their recordation, evaluation and possible treatment; or if the project substantially changes the natural environment or access to it such that the practice of traditional cultural or religious activities would be restricted. For known cultural resource sites, rerouting or redesigning to avoid impacts is typically the recommended option. If rerouting or redesigning is not possible, subsurface testing is usually recommended to determine a site's value or data potentials relative to the NRHP, to assess possible adverse project effects, and to establish the physical relationship of site boundaries with the Area of Potential Effects. In addition, 30 CES/CEIEA requires archaeological monitoring during construction through or adjacent to any known site, regardless of a site's NRHP eligibility. Archaeological monitoring is also typically required in areas where buried sites are possible (U.S. Air Force 2005b).

4.5.1 Alternative 1 (Proposed Action)

Archaeological site complex CA-SBA-537/1816 extends into SLC-4W and isolated artifact VAFB-ISO-962 is recorded within the launch complex. The isolated artifact was found in a disturbed context and represents a secondary deposit. Isolated artifacts have no regulatory status and management of VAFB-ISO-962 is not necessary.

Both CA-SBA-537 and -1816 were formally determined eligible for the NRHP by the USAF in the late 1980s, and the SHPO concurred with that determination. Extensive data recovery excavations were completed at the sites in conjunction with repairs and restoration of SLC-4. Subsurface testing at CA-SBA-537/1816 within the launch complex found it not only of poor integrity, but also the portion of the site within the launch complex was manifest as a low-density and low diversity deposit (Lebow et al. 2005).

Further study related to construction of the new landing pad that was performed and indicated that the portion of CA-SBA-537/1816 within SLC-4W lacks the qualities that make it eligible for the NRHP. Consequently, the site complex would not be adversely affected by the implementation of Alternative 1. VAFB has received concurrence from the California SHPO regarding a determination of no adverse effects. The Proposed Action would not have a significant impact on cultural resources (Appendix C).

Per 36 C.F.R. 800.3, VAFB carried out Section 106 consultation with Sam Cohen of the SYBCI, who is the tribal chairman's appointee to VAFB for Section 106 consultations, and Mr. Freddie Romero, who is the elder's council appointee for Section 106 consultations. As the SYBCI is a federally recognized tribe, this also constitutes government-to-government consultation. The 30 SW Commander appointed Christopher Ryan (30 CES/CEIEA) as the ITLO. The SYBCI was notified of the Proposed Action in an e-mail dated 14 October 2014 requesting tribal comments on the Proposed Action and initiating government-to-government consultation (Appendix F). SYBCI responded on 28 July 2015 indicating that there were no concerns with the Proposed Action (Appendix F).

The boost-back and landing of the Falcon 9 Full Thrust First Stage at SLC-4W, or on a drone ship under the Contingency Action, would not result in impacts to cultural resources at VAFB or elsewhere. Cultural resource sites would not be disturbed as a result of landing the First Stage at the landing pad at SLC-4W or 31 mi. (50 km) offshore under the Contingency Action.

4.5.2 Alternative 2

Under the Alternative Action, no construction or alteration at SLC-4W would occur. The First Stage would land on and be secured to the drone ship and transported to the Long Beach Harbor for offloading and transport back to SLC-4W. Therefore, no impacts to cultural resources would be expected under Alternative 2.

4.5.3 No Action Alternative

Under the No Action Alternative, no construction or alteration at SLC-4W would occur. Therefore, we expect no additional impacts to cultural resources under the No Action Alternative.

4.6 Geology and Earth Resources

Impacts would be considered potentially significant if the project were to result in substantially increased erosion, landslides, soil creep, mudslides, and unstable slopes. Impacts would also be considered significant if they were to increase the likelihood of or result in exposure to earthquake damage, slope failure, foundation instability, land subsidence, or other severe geologic hazards. Geologic impacts may also be considered significant if they were to result in the loss of the use of soil for agriculture or habitat, the loss of aesthetic value from a unique landform, or the loss of mineral resources.

4.6.1 Alternative 1 (Proposed Action)

4.6.1.1 Soil and Erosion

Activities with the potential to impact geology and soils would be associated with the construction of the landing pad and the realignment and widening of the existing roadways. Vegetation would be removed in areas to lay down concrete/asphalt and grade for stormwater control.

Project activities could disturb up to 3 ac. (0.01 km^2) of land. Due to the realignment and amount of disturbed land, coverage under the NPDES Construction General Permit is required. As a result, the USAF must prepare a SWPPP. The SWPPP would include erosion control measures. In addition, BMPs would be implemented during ground-disturbing activities and the EPMs detailed in Section 2.3.4.8 (Geology and Earth Resources) would be implemented. As a result, we expect no long-term or significant impacts from Alternative 1.

4.6.1.2 Seismicity

The project site is not underlain by any mapped active faults and the project does not include development of any new permanent structures beyond the concrete pad and road realignment. Although active faults located within the region could result in strong seismically induced ground

shaking, the potential for surface fault rupture and liquefaction at the project site is low. Therefore, we expect adverse impacts associated with seismically-induced ground shaking would not occur and the boost-back and landing would not have any impacts on seismicity.

4.6.1.3 Contingency Drone Ship Landing

Under the Contingency Action, no additional construction or alteration activities at SLC-4W would occur. The first Contingency Action involves the First Stage landing on a drone ship 31 mi. (50 km) west of VAFB and transported to the Long Beach Harbor for offloading and transport back to SLC-4W. For an unsuccessful drone ship landing, all recovered debris would be transported to the Long Beach Harbor for offloading. Therefore, we expect no impacts to soil and erosion or seismicity would occur under the Contingency Action.

4.6.2 Alternative 2

Under the Alternative Action, no construction or alteration at SLC-4W would occur. The First Stage would land on and be secured to the drone ship and transported to the Long Beach Harbor for offloading and transport back to SLC-4W. Therefore, we expect no impacts to soil and erosion or seismicity would occur under Alternative 2.

4.6.3 No Action Alternative

Under the No Action Alternative, no construction or alteration at SLC-4W would occur. Therefore, we expect no additional impacts to soil and erosion or seismicity would occur under the No Action Alternative.

4.7 Human Health and Safety

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

4.7.1 Alternative 1 (Proposed Action)

4.7.1.1 SLC-4W Infrastructure Improvements

Construction of the concrete landing pad could result in the exposure of construction workers to hazards associated with construction activities. These hazards include the potential for trips, slips, falls, and vehicular accidents. There is also potential for biological hazards such as spider and snake bites, disease vectors, and attack from wild animals. Because the above conditions, potential exists for persons participating in the construction and grading activities to become exposed to hazardous materials and hazardous waste. To minimize potential adverse impacts from biological hazards and physical hazards (such as from rocky and slippery surfaces), awareness training would be incorporated into the worker health and safety protocol.

Contractors would be required to develop a site specific safety plan that would address these potential hazards. Daily safety briefings would be conducted and workers would be expected to comply with federal OSHA and Air Force Occupational and Environmental Safety regulations. While adhering to these procedures, no impacts to Safety and Occupational Health would be expected. As described in Section 4.2 (Sound [Airborne]), the Proposed Action would have no significant impacts to Human Health and Safety associated with noise.

SpaceX would coordinate with 30 SW/SEW to insure VAFB policies on UXO safety for construction work is incorporated into the site safety plan. The safety program would include coordination with the AFCEC/CZO MMRP manager and contact with the weapons safety specialist for 30 SW/SEW. SpaceX would continue to implement Land Use Control Procedures, as documented in the VAFB General Plan (U.S. Air Force 2014a). Therefore, we expect no significant impacts to Human Health and Safety would occur.

4.7.1.2 Boost-Back and Landing at SLC-4W and Contingency Drone Ship Landing

Once the First Stage has landed and been secured, any remaining LOX and RP-1 would be properly off loaded and disposed or re-used. Existing procedures for offloading fuels exist and adherence would be expected of all applicable personnel. All safety precautions for SLC-4 Operations and evacuation procedures for the project site area would be followed per Space Launch Vehicle Flight Hazard Zone requirements.

With adherence to existing procedures for offloading propellants and the restrictions already in place for launch operations, and with SpaceX and subcontractors compliance with current OSHA regulations, we expect no impacts to Human Health and Safety from implementation of Alternative 1.

To minimize potential adverse impacts to Human Health and Safety, all safety precautions for SLC-4W Operations and evacuation procedures for the project site would be followed per Space Launch Vehicle Flight Hazard Zone requirements. SpaceX and Subcontractors would comply with federal OSHA regulations, and a U.S. Coast Guard COI would be completed before the drone ship landing. The U.S. Coast Guard would also be coordinated to oversee the day of landing operations for the drone ship landing. With these safety precautions in place, we expect no impacts to Human Health and Safety from implementation of the Contingency Action under Alternative 1.

4.7.1.3 Autonomous Flight Safety System

The AFSS must meet the same stringent requirements of any human-based FTS currently used on VAFB. The requirements for AFSS are specified in the Range Commanders Council 319-07 Flight Termination Systems Commonality Standard. The AFSS criteria would be configured prior to launch per specific “mission rules” established by the 30 SW/SE to protect Human Health and Safety. With these safety precautions in place, we expect no impacts to Human Health and Safety from implementation of the AFSS for Falcon 9 launch or boost-back and landing. In addition, this GPS-based system would enable very accurate tracking information and decrease response time as compared to the current FTS.

4.7.2 Alternative 2

The impacts to Human Health and Safety from the boost-back and landing of the Falcon 9 Full Thrust First Stage on the drone ship and transporting it to the Long Beach Harbor for offloading and transport back to SLC-4W, are anticipated to be similar to impacts of landing the First Stage at SLC-4W. Personnel would be expected to maintain adherence to OSHA regulations and SpaceX's Hazardous Materials Emergency Response Plan. However, there would be no new construction, and therefore none of the impacts to Human Health and Safety from construction activities would occur. With adherence to existing safety protocols for transport of hazardous materials, we expect no impacts to Human Health and Safety would occur from implementation of Alternative 2.

4.7.3 No Action Alternative

Under the No Action Alternative the landing pad construction at SLC-4W and the boost-back and landing of the Falcon 9 Full Thrust First Stage would not occur, and we expect no additional impacts to Human Health and Safety from implementation of the No Action Alternative.

4.8 Hazardous Materials and Waste Management

An impact involving hazardous materials and hazardous waste would be considered significant if their transport, use, or disposal were to pose a serious hazard to the public or the environment. Issues include the potential for accidents to release hazardous materials, emissions of hazardous materials especially within one-quarter mile of a school, and violation of any associated federal, California, or Santa Barbara County regulation or applicable permit condition.

4.8.1 Alternative 1 (Proposed Action)

4.8.1.1 Hazardous Materials

Compliance with all applicable federal, state, and local laws and regulations, and applicable VAFB plans, would govern all actions associated with implementing the Proposed Action, and should minimize the potential for significant impacts.

The use of hazardous materials during construction would be limited to vehicle maintenance (fuels, oils, and lubricants). Such materials would be required to be properly contained, manifested, and managed per all federal, state, and local regulations, AFIs, and DoD directives, and the site specific health and safety plan. Authorization from the VAFB Environmental Element would need to be acquired before use of hazardous materials. Impacts to hazardous materials for the boost-back and landing would include propellant, ordnance, and chemicals.

A site specific spill plan would be developed and spills would be quickly contained onsite consistent with existing procedures. At VAFB, hazardous materials are managed per federal and state regulations, contract specific requirements, and the VAFB Hazardous Materials Management Plan, 30 Space Wing Plan (30 SWP) 32-7086.

With adherence to existing policies and procedures as outlined in the applicable federal, state, and local regulations, as well as the EPMs described in Chapter 2 (Description of the Proposed Action and Alternatives), we expect no impacts to hazardous materials would occur.

4.8.1.2 Hazardous Waste

Hazardous waste generated from the Proposed Action would be handled and disposed of in strict adherence with the requirements of the procedures outlined in VAFB Hazardous Waste Management Plan, 30 SWP 32-7043, state, federal, DoD, and contract-specific requirements. Although propellants would be burned to depletion during flight, there is a potential for approximately 7,000 lb. of LOX and a maximum of 2,750 lb. of RP-1 to remain in the Falcon 9 Full Thrust First Stage upon landing. Final volumes of fuel remaining in the First Stage upon landing may vary. Once the First Stage has landed and been secured, any remaining LOX and RP-1 would be properly off loaded and disposed or re-used.

In the unlikely event that the FireX system is initiated, the water would be contained and tested to determine whether it is hazardous. If it is confirmed to have hazardous characteristics, it would be disposed of consistent with the above requirements.

Per existing policies and procedures as outlined in the applicable federal, state, and local regulations, as well as the EPMs described in Chapter 2 (Description of the Proposed Action and Alternatives), we expect no impacts to hazardous wastes would occur.

4.8.1.3 Environmental Restoration Program

Construction of the concrete landing pad at SLC-4W would occur within the ERP Sites 8 and 9 (Figure 3-15), in an area that has previously been remediated. Additionally, the contaminants were in the groundwater, rather than the soil, and construction activities will not excavate enough soils to reach groundwater levels. Regardless, soils and groundwater (if encountered) would be observed for unusual odor or coloring. If irregularities are discovered, then construction would cease and the VAFB environmental office would be consulted.

4.8.1.4 Contingency Drone Ship Landing

The first Contingency Action involves the First Stage landing on a drone ship 31 mi. (50 km) west of VAFB and transported to the Long Beach Harbor for offloading and transport back to SLC-4W.

If a drone ship landing occurs, hazardous materials and waste would be off-loaded after the drone ship returns the First Stage to Long Beach Harbor. Hazardous waste would be disposed of per existing policies and procedures as outlined in the applicable federal, state, and local regulations, as well the EPMs as described in Chapter 2 (Description of the Proposed Action and Alternatives). For an unsuccessful drone ship landing, most material would sink. The items that would be recovered would be transported to Long Beach Harbor and any remaining hazardous waste would be disposed of per existing policies and procedures as outlined in the applicable federal, state, and local regulations, as well the EPMs as described in Chapter 2 (Description of the Proposed Action and Alternatives). As a result, we expect no impacts to hazardous materials and wastes would occur under the Contingency Action.

4.8.2 Alternative 2

Under the Alternative Action, the construction of the landing pad and associated improvements would not occur. The boost-back and landing would occur on a drone ship located offshore and would be transported to the Long Beach Harbor for offloading and transport back to SLC-4W. Hazardous materials and ordnance would be offloaded from the first state after the drone ship is docked in Long Beach Harbor.

Per existing policies and procedures as outlined in the applicable federal, state, and local regulations, as well the EPMs as described in Chapter 2 (Description of the Proposed Action and Alternatives), we expect no impacts to hazardous materials and wastes would occur.

4.8.3 No Action Alternative

Under the No-Action Alternative, the concrete landing pad and boost-back and landing would not occur. Therefore, no additional waste would be generated, SLC-4W would remain within acceptable limits, and there would be no impacts on hazardous materials and hazardous waste management.

4.9 Solid Waste Management

Solid waste impacts are evaluated using federal, state, and local laws and regulations, permit conditions, and contract specifications. Adverse impacts would occur from noncompliance with applicable regulatory requirements or an increase in the amount of waste disposal that would exceed available waste management capacities.

4.9.1 Alternative 1 (Proposed Action)

Construction and landing operations associated with the Proposed Action would create pollution in the air and water and would generate hazardous and solid waste. Non-compliance with applicable regulatory requirements or disposal of quantities of solid waste that would cause the proposed project not to meet mandated diversion rates would be considered an adverse impact. Debris from any activities would be segregated to facilitate subsequent pollution prevention options. Pollution prevention options would be exercised in the following order: reuse of materials, recycling of materials, and then regulatory compliant disposal.

Solid waste generated during construction would include packaging from materials (cardboard and plastic), scrap rebar, wood, pipes, and wiring, and miscellaneous waste generated by onsite construction workers. Contractors would be responsible for the disposal or recycling of all waste generated during the scope of the project.

All soil excavated during construction activities would be used as backfill, and any excess materials would be spread throughout the site. Construction debris, along with green waste, used tires and other recyclable materials, would be segregated and diverted for reclamation. All green waste would be disposed of at an appropriate facility. The contractor would meet the applicable state or local diversion requirements in effect at the time of actual disposal.

Under the Proposed Action, solid waste would be minimized by strict compliance with VAFB's Integrated Solid Waste Management Plan. All materials that are disposed of off-base would be reported to the 30 CES/CEI Solid Waste Manager. Additionally, any materials recycled on-base by processes other than the base landfill, would be reported to the 30 CES/CEI Solid Waste Manager at least quarterly, with copies of weight tickets and receipts provided. Compliance with all applicable federal, state, and local laws and regulations would govern all actions associated with implementing the Proposed Action and minimize the potential for adverse effects. Therefore, we expect no significant adverse impacts to solid waste management as a result of SLC-4W infrastructure improvements or the boost-back and landing at SLC-4W under Alternative 1.

For a contingency drone ship landing, the First Stage would be secured to the drone ship and transported to the Long Beach Harbor for offloading and transport back to SLC-4W. Through prior experience, SpaceX has discovered that approximately 25 pieces of debris would remain floating after an unsuccessful drone ship landing and resulting explosion of the First Stage. All other debris sinks to the bottom of the ocean. The 25 pieces of floating debris are made primarily of Carbon over Pressure Vessels, the LOX fill line, and carbon fiber constructed landing legs. SpaceX would recover of all of these floating items and transport them back to Long Beach Harbor for offloading and transport back to SLC-4W.

Compliance with all applicable federal, state, and local laws and regulations would govern all actions associated with implementing the Contingency Action and minimize the potential for adverse effects. Therefore, we expect no significant adverse impacts to solid waste management due to the Contingency Action under Alternative 1.

4.9.2 Alternative 2

Under this alternative, the construction of a landing pad at SLC-4W would not occur. Therefore, there would be no solid waste from construction. The First Stage would be secured onto the drone ship and transported to the Long Beach Harbor for offloading and transport back to SLC-4W. Hazardous materials and ordnance would be offloaded from the First Stage after the drone ship is docked in Long Beach Harbor. Non-compliance with applicable regulatory requirements or disposal of quantities of solid waste that would cause the proposed project not to meet mandated diversion rates would be considered an adverse impact. Debris from any activities would be segregated to facilitate subsequent pollution prevention options.

Compliance with all applicable federal, state, and local laws and regulations would govern all actions associated with implementing the Alternative Action and minimize the potential for adverse effects. Therefore, we expect no significant adverse impacts to solid waste management under Alternative 2.

4.9.3 No Action Alternative

Under the No Action Alternative the landing pad construction at SLC-4W and the boost-back and landing of the Falcon 9 Full Thrust First Stage would not occur. Therefore, no additional waste would be generated, SLC-4W would remain within acceptable limits, and we expect no impacts to solid waste management would occur.

4.10 Land Use and Aesthetics

An impact on Land Use and Aesthetics would be considered significant if a project were to conflict with the designated land uses for the project area within the VAFB General Plan (U.S. Air Force 2014a) or were inconsistent with CZMA policies that protect the visual aesthetics and scenic beauty of the coastal landscape (see Section 3.11, Coastal Zone Management).

4.10.1 Alternative 1 (Proposed Action)

Land use at the proposed project site is currently classified as Launch Operations. Therefore, implementation of the Proposed Action would not conflict with this designation. The Proposed Action would be consistent with existing land use at the project site and would not result in a change to land use or be incompatible with adjacent land uses, such as agricultural land. As no prime agricultural land is present within the immediate vicinity of the Proposed Action, none would be impacted. The existing plans or stated goals of VAFB would not be in conflict with the Proposed Action.

Because the SLC-4W launch complex is already visible from Coast Road and from passing trains, any additional structural modifications or additions within the present limits of the facility due to construction activities, would not alter the existing industrial character of the site. The Proposed Action final product would also be horizontal in nature, and therefore would not be visible from the Coast Road or passing trains. Therefore, we expect impacts to Land Use and Aesthetics would not occur.

Because the drone ship landing location is at least 31 mi. (50 km) offshore, it would not visible from the coast. In addition, there are no construction activities proposed under the Contingency Action. Therefore, we expect impacts to Land Use and Aesthetics would not occur due to the Contingency Action under Alternative 1.

4.10.2 Alternative 2

Under the Alternative Action, no construction or alteration of SLC-4W would occur. The First Stage would land on and be secured to the drone ship and transported to the Long Beach Harbor for offloading and transport back to SLC-4W. Therefore, we expect no impacts to Land Use and Aesthetics.

4.10.3 No Action Alternative

Under the No Action Alternative, the landing pad construction at SLC-4W and the boost-back and landing of the Falcon 9 Full Thrust First Stage would not occur, and we expect no additional impacts to land use and aesthetics.

4.11 Coastal Zone Management

An impact on coastal resources would be considered significant if a project were inconsistent with the enforceable policies of the CCA of 1972.

4.11.1 Alternative 1 (Proposed Action)

4.11.1.1 SLC-4W Infrastructure Improvements

As required under the CZMA and the CCA of 1972, coordination with the CCC is required for development within the California Coastal Zone of for actions that may impact resources within the Coastal Zone. The location of the Proposed Action at SLC-4W is not within California Coastal Zone and the USAF, however may impact resources within the Coastal Zone. In cooperation with SpaceX, VAFB is responsible for submitting either a Coastal Zone Consistency Determination or an ND.

The proposed construction of the landing pad at SLC-4W is not anticipated to adversely impact the scenic and visual qualities of the coastal area. Construction of the pad would also not affect marine resources, including environmentally sensitive habitat areas, recreational boating use, or agricultural resources, because none of these coastal resources would occur at the proposed construction site. The potential effects on environmentally sensitive terrestrial habitats are expected to be minimal and less than significant (see Section 4.3, Biological Resources). The CCC issued concurrence with a ND (ND-0035-14; Appendix B) on 13 October 2014 that the construction of the landing pad at SLC-4W would not generate new or additional adverse impacts on coastal resources.

4.11.1.2 Boost-Back and Landing at SLC-4W

During descent of the First Stage, a sonic boom would be generated while the booster is supersonic. The overpressure would be directed at the ocean and would reach as high as 2.0 psf. The boom contours are shown in Figure 2-4. The majority of the boom occurs over the ocean. We expect the potential effects on marine resources and environmentally sensitive terrestrial habitats to be minimal and less than significant (see Section 4.3, Biological Resources).

Access to the coast at Wall and Surf Beaches would already be restricted during launches of the Falcon 9 due to security. The addition of the boost-back and landing procedure would not significantly lengthen the closure period. At program maturity, up to six launches per year may occur, with coastal access restricted for a short period of time (5 to 8 hours total). We anticipate no adverse effects to the coastal zone, as defined by the CZMA and CCA.

4.11.1.3 Contingency Drone Ship Landing

The drone ship landing site would be at least 29 mi. (47 km) beyond the 3 nautical miles (nm) (3.5 mi., 5.6 km) seaward limit of the California Coastal Zone and would not affect the scenic and visual qualities of coastal areas; terrestrial resources, including environmentally sensitive habitat areas; or agricultural resources. The U.S. Coast Guard would issue a Local Notice to Mariners that defines a Public Ship Avoidance Area around the contingency landing location.

Potential effects to nearshore marine resources at VAFB, such as haul-out sites for pinnipeds, would not occur, because noise from the First Stage drone ship landing, including the sonic boom, would not extend to the shoreline of VAFB (see Section 4.3.1.4, Marine Mammals). Haul-out and pupping sites for pinnipeds on San Miguel Island, Santa Rosa Island, and Santa Cruz Island would

be exposed to a maximum 0.2 psf sonic boom, the lowest pressure level predicted for the offshore landing site (Figure 2-10). Anticipated effects on hauled-out pinnipeds would be minor, temporary behavioral effects, as described in Section 4.3.1.4 (Marine Mammals).

Recreational boating within the coastal zone would only be temporarily delayed during transit of the drone ship, tug, and support vessel if recreational vessels were encountered. The three vessels would operate within established shipping and boating routes within the coastal zone while in route between the landing site and Long Beach Harbor. In the event of an encounter with a recreational vessel, standard rules of navigation and right-of-way would be followed, and at most, the recreational vessel would be temporarily delayed as the drone ship, tug, and support vessel transit through the area.

In the event of an unsuccessful landing attempt, the First Stage would explode upon impact with the drone ship. A debris impact analysis showed that the likelihood of debris striking individual marine mammals was negligible (Table 4-11). The noise resulting from explosion is likely to result in behavioral disruption to some marine mammal species in the exposure zone and SpaceX has applied for an IHA to authorize Level B harassment for these activities.

As described in Section 2.3.2.1.2 (For an Unsuccessful Drone Ship Landing Attempt) at most 2,750 lb. of RP-1 (or fuel) would be on board at the time of touch-down. Most of this fuel would be consumed during the subsequent explosion; residual fuel would be released onto the drone ship deck at the location of impact. In cases where the First Stage booster misses the drone ship entirely, SpaceX's scientists assume that 2,750 lb. of RP-1 would be released into the ocean. In addition, approximately 25 pieces of floating debris would be present after a First Stage explosion, which SpaceX would remove promptly. The U.S. Coast Guard would keep the Public Ship Avoidance Area in place until all floating debris is removed from the water, typically several hours.

Very light oils, including RP-1, are highly volatile, which means they evaporate quickly when exposed to the air, and are usually completely dissipated within one to two days after a spill. Clean-up following a spill is usually not necessary, or possible, with spills of very light oil, particularly with such a small quantity of oil (USFWS 1998). Therefore, no attempt would be made to boom or recover RP-1, if any of the fuel is released directly into the ocean. Any RP-1 remaining on the drone ship deck from an unsuccessful landing attempt would be recovered, contained, and handled per federal, state, and local agency requirements. Given a spill would only occur following an explosion, it is unlikely that marine mammals, seabirds, sea turtles, and fish would remain in the immediate area and be subjected to any spill. Avoidance as a behavioral reaction would not be expected to have long-term effects and would therefore not be present when an animal returned to the coastal zone. Any release of RP-1 into the ocean no less than 31 mi. (50 km) from shore would not affect the California Coastal Zone since the spill should evaporate before reaching the coastal zone. Therefore, we anticipate no adverse effects to the coastal zone or coastal resources, as defined by the CZMA and CCA.

4.11.1.4 California Coastal Commission Concurrence

The USAF submitted an ND for both the construction of a concrete landing pad and the boost-back and landing of the Falcon 9 Full Thrust First Stage launch vehicle at SLC-4W to the CCC for

review. The USAF also submitted a separate ND for the boost-back and landing of the Falcon 9 Full Thrust First Stage at the contingency landing location. The CCC concurred with both ND's, which found that the Proposed Action would not adversely affect coastal zone resources (ND-0035-14 and ND-0027-15; Appendix B). These findings are made pursuant to 15 C.F.R. 930.35 of NOAA implementing regulations.

4.11.2 Alternative 2

Under Alternative 2, the concrete landing pad at SLC-4W would not be constructed and the Falcon 9 Full Thrust First Stage would land on a drone ship 320 mi. (515 km) off the coast in the Pacific Ocean. The proposed landing site is well beyond the three nm seaward limit of the California Coastal Zone. Therefore, there would be no impacts to the coastal zone, as defined by the CZMA and CCA.

4.11.3 No Action Alternative

Under the No Action Alternative, the concrete landing pad at SLC-4W would not be constructed and the boost-back and landing of the Falcon 9 Full Thrust First Stage would not occur. Therefore, there would be no additional impacts to the coastal zone, as defined by the CZMA and CCA.

4.12 Transportation

Impacts to transportation resources would be considered significant if:

- A primary roadway could no longer service the traffic demands of that roadway;
- The project access to a primary or local road would require access that would create an unsafe situation or a new traffic signal or major revisions to an existing traffic signal; or
- The project adds traffic to a roadway that has limiting design features or receives use that would be incompatible with substantial increases in traffic, which would become potential safety problems with the addition of project or cumulative traffic. Limiting design features include, but are not limited to narrow width, roadside ditches, sharp curves, poor sight distance, and inadequate pavement structure. Some examples of a roadway receiving incompatible use are large number of heavy trucks on rural roads used by farm equipment, livestock, horseback riding, or on residential roads with heavy pedestrian or recreational use.

4.12.1 Alternative 1 (Proposed Action)

During construction activities at SLC-4W, increases to traffic would occur as a result of commuting by construction workers and the trucks transporting materials and equipment for activities associated with the construction of the landing pad and road expansion. The slight increase in daily truck traffic anticipated under the Proposed Action would not result in adverse impacts to the road capacity in and around VAFB. No new access would be required under Alternative 1, and we anticipate no unsafe roadways conditions.

The transportation of the First Stage from Long Beach Harbor after the drone ship landing under the first Contingency Action would involve additional vehicles being operated between the Long

Beach Harbor and VAFB. However, this increase in vehicle traffic, which could occur up to six times a year, would not result in adverse impacts to road capacity.

Per existing policies and procedures as outlined in the applicable federal, state, and local regulations, as well as EPMs described in Chapter 2 (Description of the Proposed Action and Alternatives), we expect no significant impacts to transportation would occur as a result of implementation of Alternative 1.

4.12.2 Alternative 2

Under Alternative 2, the construction of the landing pad and associated improvements would not occur. The boost-back and landing of the Falcon 9 Full Thrust First Stage would occur on a drone ship located offshore and would be transported to the Long Beach Harbor for offloading and transport back to SLC-4W. The transportation of the First Stage from Long Beach Harbor would involve additional vehicles being operated between the Long Beach Harbor and VAFB. However, this increase in vehicle traffic, which could occur up to six times a year, would not result in adverse impacts to road capacity.

Per existing policies and procedures as outlined in the applicable federal, state, and local regulations, as well as EPMs described in Chapter 2 (Description of the Proposed Action and Alternatives), under Alternative 2, we expect no significant impacts to transportation would occur.

4.12.3 No Action Alternative

Under the No Action Alternative, the concrete landing pad and boost-back and landing of the Falcon 9 Full Thrust First Stage would not occur. Therefore, there would be no additional impacts on transportation.

4.13 Department of Transportation Act Section 4(f) Properties

4.13.1 Alternative 1 (Proposed Action)

Construction of the landing pad and associated infrastructure would not result in restricted access to any Section 4(f) property. As discussed in Section 4.2.2.1, noise levels from construction activities would not be audible above typical ambient noise levels at the closest noise sensitive areas, including the Section 4(f) properties in the vicinity of SLC-4W. Construction noise would be intermittent and last approximately 90 to 120 days. Construction of the landing pad would not result in a use of any Section 4(f) property.

Impacts to Surf Beach, Wall Beach, County of Santa Barbara Ocean Beach Park, Miguelito Park, and Jalama Beach County Park would result from their closure to the public during launch/landing events, because these parks fall within the debris impact corridor. Although the parks are not directly over flown by the launch vehicle, a launch anomaly could impact them. Therefore, for the safety of park visitors, the County Parks Department and the County Sheriff close the parks upon request from VAFB. Since 1979, an evacuation and closure agreement has been in place between USAF and Santa Barbara County. This agreement includes closing Surf Beach, Ocean Beach, Miguelito Park, and Jalama Beach County Parks in the event of launch activities, including

commercial launches. Under this agreement, USAF must provide notice of a launch at least 72 hours prior to the closure, and the closure is not to exceed 48 hours.

Under Alternative 1, closure of the parks would have the potential to occur up to six times during the year. The closure would only last as long as necessary to assure the public is safe during a launch/landing, with coastal access restricted for a short period of time (6 to 8 hours). There would be no additional closures when landings would occur at the contingency landing site.

Alternative 1 would not substantially diminish the protected activities, features, or attributes of Surf Beach, Wall Beach, County of Santa Barbara Ocean Beach Park, Miguelito Park, and Jalama Beach County Park, and therefore would not result in substantial impairment of the properties, because there would be a maximum of six landings per year and the closures would be of short duration. Therefore, the Proposed Action would not be considered a constructive use of these Section 4(f) properties and thus would not invoke Section 4(f) of the DOT Act. This means that the FAA does not need to undertake a Section 4(f) Evaluation or determine whether the impacts are *de minimis.*

4.13.2 Alternative 2

Based on the location of the landing (320 mi. [515 km] offshore), there would be no use of Section 4(f) properties during boost-back and landing.

4.13.3 No Action Alternative

Under the No Action Alternative, there would be no additional use or impacts to Section 4(f) properties.

4.14 Utilities

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

4.14.1 Alternative 1 (Proposed Action)

Under the Proposed Action, a FireX system would be constructed with three or four remote controlled water cannons (similar to SLC-4E) mounted on posts above ground to allow for remote firefighting capabilities. Existing underground water lines are sufficient in size and capacity to support the FireX system. A tie into the water system would be required and trenching for new water lines to connect to the FireX system is required.

The pad would be constructed to control all runoff that may occur from implementation of the Proposed Action. A v-ditch surrounding the pad would convey storm water to the appropriate location as well as provide containment for potential spill or firefighting measures. In addition, all stormwater coming off the launch pad would be directed to an infiltration basin designed and

sized according to the California State Water Resources Control Board Construction General Permit. Ground based communication, tracking, and video equipment is required and existing infrastructure around the SLC-4W area (existing conduits, camera stands, junction boxes) would be used to the greatest extent possible to reduce requirements for trenching.

Existing utilities (electrical, communications, domestic water supply, and domestic wastewater) at the project site would be extended from their current location. The extensions would occur in areas that are already disturbed. No new utility usage above what has previously been experienced at the project site under the Titan IV launch program would occur. Under the Contingency Action under Alternative 1, no new utility usage above what has previously been experienced at the project site or nearby would occur. Therefore, we expect no impacts to Utilities under Alternative 1.

4.14.2 Alternative 2

Under the Alternative Action, no construction or alteration at SLC-4W would occur. The First Stage would land on and be secured to the drone ship and transported to the Long Beach Harbor for offloading and transport back to SLC-4W. Therefore, we expect no impacts to Utilities under Alternative 2.

4.14.3 No Action Alternative

Under the No Action Alternative, the landing pad construction at SLC-4W and the boost-back and landing of the Falcon 9 Full Thrust First Stage would not occur. Therefore, there would be no additional impacts to utilities.

4.15 Cumulative Impacts

The effects of Alternative 1 and Alternative 2, in combination with the effects of other relevant past, present, and reasonably foreseeable future projects have been evaluated in this cumulative effects analysis. The No Action Alternative is not analyzed as this alternative would have no cumulative effects on the environment (construction of the landing pad, and boost-back and landing of the Falcon 9 Full Thrust First Stage would not occur). A list of relevant past, present, and reasonably foreseeable projects that have been/would be constructed on VAFB is provided in Table 4-17. The foregoing analysis is based on the same resource thresholds as discussed in Sections 4.1 to 4.14.

4.15.1 Past, Present, and Reasonably Foreseeable Future Actions in the Region of Influence

The region of influence is defined as the area over which effects of the Proposed Action could contribute to cumulative impacts on the environment. Therefore, the region of influence includes both North and South VAFB. Future large projects on VAFB that are currently projected for the next several years have the greatest potential to result in cumulative impacts. VAFB projects contain environmental contract specifications and are individually evaluated for their environmental impacts. Based on the environmental impacts associated with each specific project, environmental protection measures and requirements are included in the project

activities to reduce adverse environmental effects. Thus, individually implemented measures provide cumulative protection reducing overall adverse effects on VAFB environmental resources. Table 4-17 lists the past, present, and reasonably foreseeable future actions that may contribute to cumulative effects of the Proposed Action and may be under construction at the same time as the Proposed Action. Additionally, other separate but related actions are directly related to the proposed activity and would occur at SLC-4. The environmental impacts of these actions have been documented in other analyses; however, it is important to also examine them collectively. These actions include:

- Demolition of the existing launch pad, launch tower, and mobile service tower (U.S. Air Force 2005a),
- Construction of a new concrete landing pad (this EA),
- Launch of a Falcon 9 (U.S. Air Force 2011a), and
  Falcon 9 Full Thrust First Stage boost-back and land at SLC-4W at VAFB (this EA).

Table 4-16. Federal and Non-Federal Projects

Federal Projects	Status
Falcon 9 and Falcon 9 Heavy Launch Vehicle Programs from SLC-4E	NEPA document approved. Continuing action.
Evolved Expendable Launch Vehicle Program	NEPA document approved. Continuing action.
Taurus Standard Small Launch Vehicle	NEPA document approved. Continuing action.
Demolition and Abandonment of Atlas and Titan Facilities	Programmatic Environmental Assessment complete. Continuing action.
Narlon Bridge Replacement on San Antonio Creek	NEPA underway.
East Housing Area Solar Energy Project	NEPA document approved. Construction planned for 2015.
Repairs and Replacement of Overhead Electrical Lines, Feeders K1 and K7	NEPA document approved. Construction underway.
Replacement of N5, N9, and N10 Powerlines on South VAFB	NEPA document approved. Construction planned for 2016.
Replacement of N1, N3, N6 Powerlines on South VAFB	NEPA document approved. Construction complete.
13th Street Bridge Replacement at the Santa Ynez River Crossing	NEPA underway. Construction planned for 2015.
Snowy Plover Habitat Restoration	NEPA document approved. Continuing action.
Beach Management for the Western Snowy Plover	NEPA document approved. Continuing action.
Non-Federal Projects	**Status**
City of Lompoc, North Avenue Bridge Preventative Maintenance Project	CEQA completed.

Notes: NEPA = National Environmental Policy Act, SLC-4E = Space Launch Complex 4 East

This section considers these actions cumulatively, based on the expected timeframe of their execution compared to the Proposed Action. For example, while the demolition of the existing structures would happen before the construction of the concrete pad and before the launch, the launch, In-Flight Abort test, and boost-back and landing would happen consecutively and in the same general timeframe.

Brief descriptions of each project and the resources impacted are provided below.

Falcon 9 and Falcon 9 Heavy Launch Vehicle Programs from SLC-4E

SpaceX proposed to operate the Falcon 9 and Falcon 9 Heavy launch vehicle programs from SLC-4E on VAFB. To accommodate the Falcon 9 launch program operational requirements, SpaceX proposed modifications and new construction at SLC-4E, which had been decommissioned in 2006 after the last Titan mission. In 2011, an EA was completed and a FONSI was issued (U.S. Air Force 2011a). The analyses of the affected environment and environmental consequences concluded that with implementation of the environmental protection and monitoring measures, no significant impact or adverse effects would result to cultural resources, hazardous materials and waste management, human health and safety, orbital debris, socioeconomics, solid waste management, transportation, and water resources. In addition, the EA concluded that the project would not affect environmental justice. On 16 November 2010, the CCC concurred with the ND under the CZMA submitted by the USAF for the project. Likewise, on 16 November 2010, the California State Historic Preservation Officer concurred with the finding of No Adverse Effect for the Proposed Action in compliance with Section 106 of the NHPA. No cumulative significant or adverse impacts should result from activities associated with the modifications to SLC-4E and operation of the Falcon 9 and Falcon 9 Heavy launch vehicle programs, when considered in conjunction with past, present, or reasonably foreseeable future agency projects near and on VAFB. Two areas of environmental consequences, air quality and biological resources, evaluated in the EA were determined to have the potential to result in less than significant impacts to the environment. Construction has been completed.

Evolved Expendable Launch Vehicle Program

The Evolved Expendable Launch Vehicle (EELV) system was designed to be modular with only flight-worthy components being delivered to the launch base, including VAFB. This approach reduces manufacturing costs and allows the government to leverage off the commercial market to reduce overall launch costs. An EIS (U.S. Air Force 1998) was prepared to analyze potential impacts on 15 separate environmental resource areas as a result of implementing the action. These resource areas included local community, land use and aesthetics (including coastal zone management), transportation, utilities, hazardous materials and hazardous waste management, health and safety, geology and soils, water resources, air quality (lower atmosphere), air quality (upper atmosphere), noise, orbital debris, biological resources, cultural resources, and environmental justice. Resource areas identified as having potentially significant impacts included those associated with coastal zone management, hazardous materials and hazardous waste management, geology and soils, water resources, air quality (lower atmosphere), air quality (upper atmosphere), noise, orbital debris, biological resources, and cultural resources. A Record of Decision was issued in 1998 to permit the continued development and deployment of the EELV.

Taurus Standard Small Launch Vehicle Program

This action included the Taurus Standard Small Launch Vehicle program and modifications to Facility 576E, including construction of a launch pad area, guard shacks, and security fencing. We assessed potential environmental effects for Air Quality, hydrology and water quality, geology

and soils, biological resources, visual resources, population, land use, community facilities and services, transportation, economy, waste management, health and safety, noise, and cultural resources (U.S. Air Force 1992). The action was determined to have no significant effect on geology and soils, visual resources, population, land use, community facilities and services, transportation, economy, waste management, and health and safety. Potentially significant impacts to air quality, water quality, biological resources, noise, and cultural resources were identified. These impacts were avoided or reduced to insignificant levels through the implementation of mitigation measures and project procedures. A FONSI was issued in 1992.

Demolition and Abandonment of Atlas and Titan Facilities

This action was to demolish or abandon Atlas and Titan Heritage launch program buildings no longer required to sustain either current or foreseeable VAFB missions. Buildings that were proposed for demolition or abandonment were located throughout VAFB: 28 buildings on North VAFB and 35 buildings on South VAFB. The action entails the total above-grade demolition, complete abandonment, or partial demolition and partial abandonment of specific structures at each of the buildings. A Programmatic EA (U.S. Air Force 2006a) concluded that with implementation of the project and monitoring measures described, no significant effects should result to cultural resources, hazardous materials and hazardous waste management, human health and safety, solid waste management, transportation, and water resources. The Programmatic EA found that this action could result in less than significant impacts to air quality, biological resources, cultural resources, land use and aesthetics, and water quality. No cumulative adverse impacts would result from the action when considered in conjunction with recent past and future projects. A FONSI was issued for the action in 2006, and the project is underway.

Narlon Bridge Replacement on San Antonio Creek

The Union Pacific Railroad (UPRR) needs to replace the antiquated Narlon Bridge over San Antonio Creek, which is located inside UPRR right-of-way, within the boundaries of north VAFB. To accomplish the bridge replacement, UPRR would encroach on VAFB (federal) property for the purposes of accessing the project site and temporary staging of equipment during construction. Because federal property would be accessed, the bridge replacement project is subject to environmental evaluation under federal law, in compliance with NEPA. An EA is being prepared that evaluates environmental impacts that could occur on both VAFB and UPRR property for the entire bridge replacement project. The resources that are being analyzed include air quality, biological resources and wetlands, cultural resources, socioeconomics, water resources, geology and earth resources, public health and safety, transportation, and cumulative impacts. It was determined that the project would not impact or have a negligible impact on environmental justice, land use and coastal resources, public utilities, noise, recreation, and visual resources.

East Housing Solar Energy Project

VAFB proposed leasing land to and entering into a Power Purchase Agreement with a private developer who would design, construct, operate, and maintain an unmanned photovoltaic solar energy facility at the former East Housing Area on and for the benefit of VAFB. The portion of the East Housing Area selected for the project was approximately 182 ac. (0.74 km^2) in size and had

few environmental constraints. The East Housing Area had topographic and other locational characteristics needed for cost-effective renewable energy generation, including existing on-site presence of key infrastructure (e.g., roads, power lines, water). The Project is projected to provide almost 25 percent of VAFB's electrical energy. The Project is designed to have a useful life of 20–30 years, although the life span could be extended by upgrades and refurbishments. An EA was completed in 2014, and a FONSI was issued in 2014 (U.S Air Force 2014c). The Project is expected to be operational in 2016.

Based on the EA, this project would not result in individual or cumulatively significant impacts to any resources. However, adverse impacts were noted for the action during construction or operation to the following resources: air quality, biological resources, noise, transportation, visual resources, and water resources. Beneficial impacts were noted for air quality as a result of future use of a renewable energy source at VAFB.

Repairs and Replacement of Overhead Electrical Lines, Feeders K1 and K7

This project included demolition and replacement of approximately 21 mi. (34 km) of existing electrical lines and construction of new overhead electrical lines and permanent access roads on South VAFB. An EA was completed in 2012 (U.S. Air Force 2012b). Potential adverse impacts were analyzed for air quality, biological resources, cultural resources, geology and earth resources, land use and coastal zone resources, noise, public health and safety, transportation, and water resources. Portions of the proposed Feeder Line K7 were located within the Santa Ynez River floodplain; therefore, the USAF analyzed potential impacts to floodplains and issued a Finding of No Practicable Alternative (FONPA) in 2012. Based on the EA, this project was not determined to have an individual or cumulatively significant impact on these resources. A FONSI/FONPA was issued in 2012 (U.S. Air Force 2012b). The project is currently under construction.

Replacement of N5, N9, and N10 Powerlines on South VAFB

This action involves demolishing existing electrical lines and constructing new overhead electrical lines. The new electrical lines would be established along a new route located east of the existing route, along two parallel sets of power poles between "Substation N" and SLC-6 for approximately 1.5 mi. (2.4 km). A 15 ft. (4.6 m) gravel road would be established between the two sets of power poles to allow for future maintenance of the lines. An EA is currently being prepared for this action and has concluded that by implementing environmental protection measures, no significant adverse effects would result to the following resources: air quality, biological resources, cultural resources, geology and earth resources, hazardous materials and hazardous management, human health and safety, land use and coastal zone resources, noise, solid waste, transportation, utilities, visual resources, and water resources. In addition, no significant adverse cumulative impacts would result from this action or the alternatives when considered with past, present, or reasonably foreseeable future projects at VAFB.

Repairs and Replacement of Overhead Electrical Line, Feeders N1, N3, and N6

VAFB proposed demolishing approximately 20 mi. (32 km) of existing overhead electrical lines on South VAFB and replacing them with approximately 11 mi. (18 km) of new overhead lines. An EA (U.S. Air Force 2011c) concluded that by implementing environmental protection measures, no significant adverse effect would result to the following resources: air quality, GHGs, biological

resources, geology and earth resources, land use and coastal zone resources, noise, public health and safety, transportation, visual resources, and water resources. No significant cumulative impacts were anticipated to these resources. The EA determined that the action would not affect environmental justice, socioeconomics, public services and utilities, and recreation. Adverse direct and cumulative impacts were anticipated to cultural resources. Therefore, the USAF implemented Alternative B, which realigned the powerline route to avoid impacts to these resources. A FONSI was issued in 2011.

13th Street Bridge Replacement at the Santa Ynez River

This project has the following main components: construction of a new bridge on 13th Street over the Santa Ynez River and corresponding approach roads; demolition and removal of the existing 13th Street Bridge and existing approach roads; installation of a fiber optic communication cable under the Santa Ynez River; restoration of areas temporarily disturbed by construction and demolition activities; and establishment of a Wetland Mitigation Area at the Santa Ynez River Estuary to offset any potential project-related impacts to wetlands that cannot be restored within the main project area. The action would occur in two project areas within the lower Santa Ynez River area, referred to as the Wetland Mitigation Area and the 13th Street Bridge Project Area. The 13th Street Bridge Project Area includes the site of the new bridge construction, the demolition of the existing bridge, the installation of the fiber optic cable under the Santa Ynez River, and the restoration of temporary impacts from construction and demolition. Construction of the new bridge and demolition of the existing bridge is anticipated to begin in 2016 and last approximately 12–20 months. An EA was completed in 2014, and a FONPA was issued in 2014 (U.S. Air Force 2014d). The Project is expected to begin in 2016.

The EA determined that the project would not result in individual or cumulatively significant impacts to any resources. However, potential adverse impacts were noted for the following resources: air quality, biological resources, cultural resources, earth resources, hazardous materials and waste management, human health and safety (noise), land use and aesthetics, solid waste management, transportation, and water resources. Some aspects of the project were noted as potentially beneficial to biological resources and water resources.

Snowy Plover Habitat Restoration

The western snowy plover habitat restoration project consists of implementing habitat restoration for the benefit of the snowy plover and the coastal dune ecosystem on VAFB, and includes the removal of invasive, non-native species and revegetation with native dune species where appropriate. Eradication methods for targeted invasive species include manual and mechanical removal, and fire and chemical treatment. Active restoration began in 2008 and is ongoing. An EA was prepared in 2008 (U.S. Air Force 2008). The EA determined that, with the implementation of environmental protection and monitoring measures, no adverse effects would result to hazardous materials and waste management, human health and safety, land use and aesthetics, and water resources. Three resources evaluated in the EA were determined to potentially have less than significant impacts: air quality, biological resources, and cultural resources. No cumulative adverse impacts were expected. A FONSI was issued in 2008.

Beach Management for the Western Snowy Plover

The USAF VAFB Beach Management Plan includes public and military access to the beaches on VAFB; enforcement; predator management; management of the LETE colony; and beach restoration activities, water rescue training, and coastline familiarization. An EA was originally prepared in 2006 (U.S. Air Force 2006b) to analyze potential impacts to biological resources, cultural resources, human health and safety, land use and aesthetics, and environmental justice. The USAF determined that the action would not result in significant individual or cumulative impacts to resources, and a FONSI was issued in 2006.

City of Lompoc, North Avenue Bridge Preventative Maintenance Project

The City of Lompoc proposed repairing the North Avenue Bridge at the San Miguelito Creek crossing. This project includes applying a bridge deck seal, repairing minor spalls in concrete bridge support columns, controlling traffic, controlling water pollution, removing traffic striping and markings, and installing traffic striping and markings. The construction impact area included 0.4 ac. (1,618 m^2) of un-vegetated paved road surface, concrete, and compacted dirt. It was determined that the project did not encroach on or impact the floodplain. The following resources were determined to be potentially affected by the project: biological resources, air quality, hazards and hazardous materials, and noise. The project was determined to have no effect on land use and planning, population and housing, geology and soils, cultural resources, agricultural resources, aesthetics, utilities, public services, and recreation. The project was determined to have less than significant impacts on noise and transportation. With mitigation incorporated, the project was determined to have less than significant impacts on water quality, air quality, biological resources, and hazards and hazardous materials. A Mitigated Negative Declaration was issued in 2014 (City of Lompoc 2014a). A Categorical Exclusion from the requirements to issue an EA under NEPA was issued in 2014 (City of Lompoc 2014b).

4.15.2 Alternative 1 (Proposed Action)

4.15.2.1 Air Quality

VAFB has several other construction or demolition projects in the ROI for the Proposed Action. Air emissions from other projects listed in Table 4-17 would be localized and short-term in nature, except for the Basewide Demolition project, which is anticipated to continue over the course of 15 years, contingent on funding. Long-term emissions from the projects are not anticipated to increase. Cumulative emissions from Proposed Action combined with other concurrent construction projects and launch operations would not exceed the significance thresholds in Santa Barbara County and would not produce any significant cumulative air quality impacts. The incremental contribution of the Proposed Action to GHG emissions is extremely small relative to regional emissions and therefore would not have a significant impact to cumulative GHG emissions or climate change. This determination was made by reviewing the total emission impact of this project with the cumulative emissions from all planned concurrent projects (Table 4-17). Therefore, implementation of the Proposed Action in conjunction with other past, present or reasonably foreseeable projects would not result in cumulative impacts to air quality or climate change.

4.15.2.2 Noise (Airborne)

Construction activities at the site of the Proposed Action and for other projects listed in Table 4-17 would result in temporary, intermittent impacts localized to the project site. Construction projects are typically temporary in duration and the noise impact from the construction of the landing pad would not be a significant contributor to the noise setting on VAFB.

There are about eight launches a year at VAFB (space and missile launches). Noise effects associated with each of these launches is relatively short (no more than five minutes). When required, appropriate environmental analysis is conducted for these activities. Noise associated with the boost-back is anticipated to be short (about two minutes) and would not create a significant cumulative impact when compared to other launch related activities. The anticipated sonic boom events would be infrequent (up to 6 events per year) and each event would last less than two minutes. Therefore, implementation of the Proposed Action in conjunction with other past, present or reasonably foreseeable projects would not result in cumulative noise impacts.

4.15.2.3 Biological Resources

The Proposed Action and other construction and launch projects that involve ground-disturbing activities and related noise and traffic impacts could have temporary and localized effects on biological resources. Cumulative adverse impacts could result if concurrent projects, along with the Proposed Action, cause disturbances to special-status species or their habitats. Construction of the landing pad would be limited to a small area within SLC-4W. Loss of non-native vegetation communities is not considered adverse due to the abundance of vegetation communities in the project vicinity. Additionally, boost-back and landing is a short and infrequent operation (up to 6 events per year) and would not be expected to have residual effects past each operation.

Although the Proposed Action and other concurrent projects may disturb wildlife, the disturbance would be temporary and wildlife would continue to use habitat in the periphery of the projects. Compliance with a project-specific BO and implementation of environmental protection measures would minimize impacts to special-status species. Therefore, implementation of the Proposed Action in conjunction with other past, present or reasonably foreseeable projects would not result in cumulative impacts to biological resources.

4.15.2.4 Water Resources

Cumulative impacts to water resources could occur if concurrent projects were to inadequately address water resources at project locations. However, projects on VAFB, including the Proposed Action, are required to utilize site-specific BMPs to control runoff and conduct site restoration, as necessary, to minimize impacts to water quality. Impacts tend to be localized and temporary during construction activities. In addition, all VAFB cumulative projects, as shown in Table 4-17, would follow the conditions of the CWA Section 404 Permit and 401 Water Quality Certification, the SWPPP prepared for the NPDES Construction General Permit, Post Construction Storm Water Standards, or Energy Independence and Security Act of 2007 Section 438, as applicable. Erosion and contamination caused by construction activities are not anticipated as a result of the Proposed Action. Therefore, implementation of the Proposed Action in conjunction with other

past, present or reasonably foreseeable projects would not result in cumulative impacts to water resources.

4.15.2.5 Cultural Resources

Activities that disturb intact, native soils or demolish structures over 50 years of age could result in impacts to cultural resources. Cumulative impacts would result if construction activities resulted in major ground disturbances in areas of high paleontological sensitivity (subsurface prehistoric or historic archaeological resources). Although a portion of one site (CA-SBA-537/1816) is located in the vicinity of the Proposed Action, VAFB has received concurrence from the California SHPO regarding a determination of no adverse effects.

In addition, EPMs would be implemented to minimize impacts on sensitive archaeological resources. Vehicular access would be prohibited within known cultural sites. While some areas within the landing site at SLC-4W have been previously disturbed, the potential remains for currently buried, unknown cultural resources to be uncovered during ground-disturbing activities, as well as in those areas that are as of yet undisturbed. However, if such resources were uncovered during the course of project development, construction would be suspended until a qualified archaeologist could determine the significance of the encountered resource(s). Therefore, implementation of the Proposed Action in conjunction with other past, present or reasonably foreseeable projects would not result in cumulative impacts to cultural resources.

4.15.2.6 Geology and Earth Resources

Cumulative projects at VAFB that involve grading, excavations, construction or demolition could result in erosion-induced sedimentation of adjacent drainages and water bodies. The soils in the region of influence have been altered over time and some of the project site is permanently disturbed with existing infrastructure and paved surfaces. Potential cumulative effects would include an increase in soil disturbance associated with construction and road building activities, substantially increased erosion, landslides, soil creep, mudslides, and unstable slopes. These impacts would be minimized by the use of BMPs and site restoration to minimize soil erosion and reduce fugitive dust. Erosion-induced sedimentation of surface drainages could occur as a result of cumulative projects at VAFB.

All projects located in the region are subject to seismically induced ground shaking due to an earthquake on a local or regional fault. By incorporating modern construction engineering and safety standards, all adverse seismic-related impacts at the project site, as well as the projects in the region should be avoided. Therefore, implementation of the Proposed Action in conjunction with other past, present or reasonably foreseeable projects would not result in cumulative impacts to geology and earth resources.

4.15.2.7 Human Health and Safety

The Proposed Action and other concurrent projects on VAFB could result in increased risks to human health and safety. Implementation of the Proposed Action and other similar actions at VAFB would slightly increase the short-term risk associated with construction contractors performing work at project locations. Contractors would be required to establish and maintain

safety programs that would provide protection to their workers and limit the exposure of Base personnel to construction hazards. Impacts would be minimal and confined to the immediate project site. The safety program would include coordination with the AFCEC/CZO MMRP manager and contact with the weapons safety specialist for 30 SW/SEW for information on VAFB policies on UXO safety for construction work at VAFB. With appropriate safety measures in place, implementation of the Proposed Action in conjunction with other past, present or reasonably foreseeable projects would not result in cumulative health and safety impacts.

4.15.2.8 Hazardous Materials and Waste Management

Management of any hazardous materials would occur under compliance of VAFB Hazardous Materials Management Plan and emergency responses to spills would follow the Hazardous Materials Emergency Response Plan, for all projects. Projects must also follow the Integrated Solid Waste Management Plan. EPMs would be implemented to minimize hazardous materials or hazardous waste management impacts. The Proposed Action would not contribute to cumulative effects to hazardous materials and wastes in or around VAFB. Therefore, implementation of the Proposed Action in conjunction with other past, present or reasonably foreseeable projects would not result in cumulative impacts associated with hazardous materials and wastes.

4.15.2.9 Solid Waste Management

The cumulative projects listed in Table 4-17, including the Proposed Action would result in an overall increase in solid waste generation resulting from construction, renovation, and demolition. Solid waste would be minimized by compliance with VAFB's Integrated Solid Waste Management Plan and the implementation of EPMs, including segregating, reusing, and recycling waste to the greatest extent practicable, would reduce cumulative impacts of solid waste. Local landfills would be able to process the projected temporary increases in solid waste. We expect no significant cumulative impacts on solid waste management.

4.15.2.10 Land Use and Aesthetics

The Proposed Action would not adversely affect land use or aesthetics. The cumulative projects identified in Table 4-17 are all on VAFB and would conform to USAF regulations and planning principles or comply with County/State requirements. Cumulative projects would be modified if during the project review process to ensure compatibility with existing land uses and consistency with management plans. These projects have been and would be assessed separately under NEPA and the effects would be analyzed and disclosed. Therefore, implementation of the Proposed Action in conjunction with other past, present or reasonably foreseeable projects would not result in cumulative impacts on land use or aesthetics.

4.15.2.11 Coastal Zone Management

The Proposed Action would not adversely affect the Coastal Zone, CZMA, or CCA policies. The cumulative projects identified in Table 4-17 are all on VAFB and would conform to USAF regulations and CZMA and CCA policy. Cumulative projects, if necessary, would be modified

during the project review process to ensure consistency with the CZMA and CCA policy. Therefore, implementation of the Proposed Action in conjunction with other past, present or reasonably foreseeable projects would not result in cumulative impacts to coastal zone resources.

4.15.2.12 Transportation

Cumulative construction and demolition projects on VAFB would contribute to increased traffic volumes in the region. Roadways on VAFB and near the installation currently have low ADT volumes and acceptable level of service conditions. Any disruption to these roadways as a result of the Proposed Action would be relatively small with a temporary increase in ADTs during construction activities. No long-term increases in traffic would occur as a result of implementation of the Proposed Action. Therefore, implementation of the Proposed Action in conjunction with other past, present or reasonably foreseeable projects would not result in cumulative impacts to transportation on VAFB.

4.15.2.13 Utilities

Cumulative construction and demolition projects on VAFB would contribute to increases in demand for utility resources; however, utility capacity would be required to be greater than demand. If existing utility capacity is not greater than the anticipated demand, VAFB would increase capacity to exceed demand or extend existing utilities to reach project areas. In addition, several of the cumulative projects listed in Table 4-17 are intended to improve and secure utility capacity (e.g., repairs and replacements to overhead electric lines and feeders) and thus help offset cumulative impacts to utility resources. Therefore, implementation of the Proposed Action in conjunction with other past, present or reasonably foreseeable projects would not result in cumulative impacts to utilities on VAFB.

4.15.3 Alternative 2

Under Alternative 2, the boost-back and landing of the First Stage Falcon 9 would occur as described in Section 2.3.2.1 (Contingency Drone Ship Landing), except that it would land 320 mi. (515 km) offshore and the construction of a landing pad at SLC-4W would not occur. As analyzed above under Alternative 1, no significant cumulative impacts when added to other past, present, and reasonably foreseeable future actions were identified for the boost-back and landing under any resource area. Given the location of the Falcon 9 landing under Alternative 2 (320 mi. [515 km] offshore), no significant cumulative impacts would occur because landing activities would not overlap with those projects listed in Table 4-17 and because the distance to the off shore landing location would not represent additive impacts given the lack of other potential activity in the area. Therefore, implementation of the Alternative 2 in conjunction with other past, present or reasonably foreseeable projects would not result in cumulative impacts.

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APPENDIX A: Interagency and Intergovernmental Coordination for Environmental Planning

KAISERSATT, SAMANTHA O CIV USAF AFSPC 30 CES/CEIEA

From:	KAISERSATT, SAMANTHA O CIV USAF AFSPC 30 CES/CEIEA
Sent:	Tuesday, May 26, 2015 4:37 PM
To:	'Jorgenson, David A SPL'; 'Phillips, Jeff'; 'lsimon@coastal.ca.gov'; 'sheila.soderberg@waterboards.ca.gov'; 'pearsonm@sbcapcd.org'; 'FRomero@santaynezchumash.org'; 'SCohen@santaynezchumash.org'; 'dvillalo@co.santa-barbara.ca.us'; 'hallen@co.santa-barbara.ca.us'; 'president@cnpsci.org'; 'BTrautwein@EnvironmentalDefenseCenter.org'; 'lswetland@sbnature2.org'; 'gching@cox.net'; 'mary.hamilton@waterboards.ca.gov'; 'Boggs, Melissa@Wildlife'; 'kurtfz63@yahoo.com'; 'bima55@msn.com'; 'martin.potter@wildlife.ca.gov'; 'mary.meyer@wildlife.ca.gov'; 'sachs.carol@epa.gov'; 'carol.roland-nawi@parks.ca.gov'
Cc:	Daniel.Czelusniak@faa.gov; Tina Norwood (tina.norwood-1@nasa.gov)
Subject:	Environmental Assessment for the U.S. Air Force Boost-back and Landing of the Falcon 9 First Stage Booster
Attachments:	Proposed Action.pdf
Signed By:	samantha.kaisersatt@us.af.mil

To whom it may concern,

Pursuant to the National Environmental Policy Act (NEPA) of 1969, as amended, and its implementing regulations, the United States Air Force (Air Force) intends to prepare an Environmental Assessment (EA) to analyze the potential impacts on the human environment from the proposed boost-back and landing of the Falcon 9 first stage booster at Space Launch Complex 4 West (SLC-4W) on Vandenberg Air Force Base, California. In addition, the Proposed Action includes two contingency actions; the boost-back and landing of the Falcon 9 first stage on a barge specifically designed for the landing located at least 31 miles (50 km) offshore of VAFB, and landing the Falcon 9 first stage in the water at least 31 miles (50 km) offshore of VAFB. One of these actions would occur if landing the Falcon 9 first stage on the pad at SLC-4W does not occur. A summary of the Proposed Action is included as an attachment to this email. As required by the NEPA, a No-Action Alternative will also be addressed, whereby the current launch processes would continue without using the boost-back capabilities of the Falcon 9 first stage. Depending on the trajectory of the launch vehicle, the first stage would drop into the Pacific Ocean approximately 300 to 500 miles (480 to 800 km) west of the Baja California coast (in all launch azimuth directions). The first stage is not recoverable due to previous attempts at recovering first stages during boost-back attempts at sea. The first stage would subsequently sink and therefore would not be recovered.

The Air Force requests advanced comment to determine if the EA should consider any other alternatives.

Space Exploration Technologies(SpaceX) is the proponent for the Proposed Action and the Air Force is the lead federal agency for NEPA. To ensure that launch services provided by private enterprises are consistent with national security and foreign policy interests of the United States and do

not jeopardize public safety and the safety of property, the Commercial Space Launch Act of 2011 (51 United States Code [U.S.C.] Subtitle V, ch. 509, §§ 50901-50923)1984 (Public Law 98-575), as codified at 49 U.S. Code (U.S.C.) 70101-70119, authorizes the Department of Transportation (DOT) to license and regulate U.S. commercial launch activities. Within the DOT, the Secretary of Transportation's authority under the Commercial Space Launch Act has been delegated to the Federal Aviation Administration (FAA) Office of Commercial Space Transportation. Therefore, the FAA is a cooperating agency in reviewing the preparation of this EA. As applicable and at the request of the National Aeronautical and Space Administration (NASA), they are also a cooperating agency.

The proposed boost-back and landing of the Falcon 9 first stage booster and any practicable alternatives will be analyzed in a forthcoming EA and the public will have an opportunity to comment when the EA is released.

Though comments and information will be accepted throughout the EA process, please provide your comments or requested information no later than June 25, 2015 to ensure incorporation into the Draft EA. Comments or requests for more information may be submitted to: Samantha Kaisersatt, NEPA Project Manager via email (samantha.kaisersatt@us.af.mil) or by standard mail to: 30 CES/CEIEA, Attn: Samantha Kaisersatt, 1028 Iceland Avenue, Vandenberg Air Force Base, CA 93437.

In advance, we thank you for your assistance in this matter.

//SIGNED//
Samantha Kaisersatt
Environmental Planner
30 CES/CEIEA
1028 Iceland Ave.
Vandenberg AFB, CA 93437
COMM: 805-605-0392
DSN: 275-0392
samantha.kaisersatt@us.af.mil

County Of Santa Barbara

Mona Miyasato
County Executive Officer

105 East Anapamu Street, Room 406
Santa Barbara, California 93101
805-568-3400 • Fax 805-568-3414
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Executive Office

June 25, 2015

Ms. Samantha Kaisersatt
NEPA Project Manager
30 CES/CEIEA
1028 Iceland Avenue
Vandenberg Air Force Base, CA 93437

E-mail: samantha.kaisersatt@us.af.mil

Re: Proposed Action – Boost-back and Landing of the Falcon 9 First Stage Booster

Ms. Kaisersatt:

Thank you for the opportunity to comment on the Proposed Action for Vandenberg Air Force Base's Boost-back and Landing of the Falcon 9 First Stage Booster. At this time, the County is submitting the attached letters from the Fire Department and the Community Services Department, Parks Division.

The County has no further comments on this project at this time and looks forward to hearing more about the project's progress. If you should have any further questions, please do not hesitate to contact my office directly or Matt Schneider, Deputy Director, in the Office of Long Range Planning at (805) 568-2072.

Sincerely,

Renée E. Bahl

for Mona Miyasato
County Executive Officer

cc: Glenn Russell, Ph.D., Director, Planning and Development Department
Matt Schneider, Deputy Director, Long Range Planning Division
Claude Garciacelay, Planner, Community Services Department
Martin Johnson, Deputy Fire Marshal, Fire Department

Attachments: June 2nd Letter, Fire Department
May 27th Letter, Parks Department

Renée E. Bahl
Assistant County Executive Officer
rbahl@co.santa-barbara.ca.us

Terri Maus-Nisich
Assistant County Executive Officer
tmaus@countyofsb.org

Fire Department

"Serving the community since 1926"

HEADQUARTERS

4410 Cathedral Oaks Road
Santa Barbara, CA 93110-1042
(805) 681-5500 FAX: (805) 681-5563

Eric L. Peterson
Fire Chief
County Fire Warden

Rob Heckman
Deputy Fire Chief

June 2, 2015

Ms. Samantha Kaisersatt, NEPA Project Manager
30 CES/CEIEA
1028 Iceland Avenue
Vandenberg Air Force Base, CA 93437

Dear Ms. Kaisersatt:

SUBJECT: Vandenberg Air Foce Base Boost-Back and Landing of the Falcon 9 First Stage Booster

I have reviewed the above referenced project. The project is not located within the boundaries of the Santa Barbara County Fire Protection District, therefore, we have no conditions or objections to this project as presented at this time. VAFB Fire Department review and comments are essential to this development

As always, if you have any questions or require further information, please call 681-5525 or 681-5523.

In the interest of life and fire safety,

Martin Johnson
Deputy Fire Marshal

MJ: mkb

Community Services Department

Renée E. Bahl, Interim Director, Community Services
Paddy Langlands, Deputy Director, Parks Division
Dinah Lockhart, Deputy Director, Housing & Community Development
Ryder Bailey, Chief Financial Officer, Community Services
Ginny Brush, Executive Director, Arts Commission
Angela Hacker, Manager, emPower Central Coast

May 27, 2015

Samantha Kaisersatt, NEPA Project Manager
30 CES/CEIEA
1028 Iceland Avenue
Vandenberg Air Force Base, CA 93437

RE: RAR – Vandenberg Air Force Base
Boost-Back and Landing of Falcon 9 First Stage Booster

Dear Ms. Kaiserstatt:

County of Santa Barbara, Community Services Department, Parks Division would like to provide the following comment on the above referenced RAR.

County Parks operates a camping park, Jalama Beach County Park, on the beach adjacent to the southern property boundary of VAFB and a day use park, Ocean Beach County Park at the mouth of the Santa Ynez River, and Miguelito County Park on Miguelito Canyon Road. The County and VAFB have in place an evacuation agreement that requires that the parks be cleared of the recreating public using the facilities (i.e. campers and day users at Jalama and day users at Ocean and Miguelito) prior to launches. The County is concerned that this new launch program may have the effect of more launches emanating from the base, and thereby causing additional closures and evacuations of Jalama Beach and other county parks/facilities having a detrimental impact on the recreating public.

County Parks would like to request that the Environmental Assessment include an analysis of impacts to recreation from the Falcon 9 program and specifically address potential impacts to use at Jalama Beach and Ocean Beach County Parks. Though not managed by County Parks, we recognize that public beach access also occurs at Surf Station and this facility should also be included as part of the impact analysis.

Thank you for the opportunity to comment. Should you have any questions or require additional information, please contact me at (805) 568-2469 or cgarcia@sbparks.org .

Sincerely,

Claude Garciacelay
Park Planner

APPENDIX B: California Coastal Commission Consultation

CALIFORNIA COASTAL COMMISSION
45 FREMONT, SUITE 2000
SAN FRANCISCO, CA 94105-2219
VOICE (415) 904-5200
FAX (415) 904-5400
TDD (415) 597-5885

October 13, 2014

Beatrice L. Kephart
Chief, Installation Management Flight
30 CES/CEI
ATTN: Andrew Edwards
1028 Iceland Avenue
Vandenberg Air Force Base, CA 93437-6010

Subject: Negative Determination ND-0035-14 (SpaceX Dragon In-Flight Abort Test and Falcon 9 First Stage Landing at Space Launch Complex-4 West, Vandenberg Air Force Base, Santa Barbara County)

Dear Ms. Kephart:

The Coastal Commission staff has reviewed the above-referenced project at Vandenberg Air Force Base (AFB). The U.S. Air Force proposes to oversee the Space Exploration Technologies Corporation's (SpaceX) proposed Falcon 9 rocket launch at Space Launch Complex-4 East (SLC-4E), the in-flight abort test of the Dragon spacecraft capsule and recovery operations approximately 1.5 miles off the VAFB coast, and the Falcon 9 first stage landing at SLC-4W. The Executive Director previously concurred with a negative determination from the Air Force (ND-055-10) in November 2010 for modifications to SLC-4E to support the Falcon 9 and Falcon 9 Heavy launch vehicle programs at Vandenberg AFB. The Air Force states in the subject negative determination that the proposed launch will be integrated into the Vandenberg AFB range infrastructure and will comply with range, safety, and communications requirements. The Air Force will monitor and maintain oversight of the launch process and communications with the rocket while on the ground and in flight, and will track the capsule and first stage to ensure that they operate safely within their predetermined performance envelopes.

The proposed Falcon 9 launch, recovery, and landing project includes the following elements:

- *Construction of a 300-foot diameter, 1.6-acre concrete landing pad at SLC-4W, requiring 25,000 cubic yards of grading with balanced cut and fill on the site.*

- *Installation of a 5.7-acre area of flat panels supported by scaffolding immediately west of the landing pad. This temporary structure provides a uniform flat surface extending west off the landing pad to allow the radar sensors on the Falcon 9 first stage to gauge altitude and vertical velocity as the vehicle makes its final descent to the pad. The scaffolding and panels will be installed two weeks prior to launch and removed two weeks after.*

- *Realignment and widening of sections of the existing service and access roads connecting SLC-4W and 4E in order to accommodate the transfer of the Falcon 9 first stage from the landing pad at SLC-4W to the hanger at SLC-4E.*

- *Installation at SLC-4W of ground-based communication, tracking, and video equipment, and three or four remote-controlled water cannons for firefighting capability.*

- *All storm water and/or firefighting runoff from the landing pad will be collected and diverted to an infiltration basin designed according to the California State Water Resources Control Board construction general permit.*

The Air Force anticipates 90-120 days of construction activity at SLC-4W, including 30 days during which concrete would be curing and only minimal construction activity would occur. The current schedule calls for construction to commence no sooner than February 2015 and the launch to take place in the summer of 2015.

Endangered Species Act Section 7 consultation with the U.S. Fish and Wildlife Service is currently underway to establish protective measures for federally listed species that may be affected by the proposed construction, launch, landing, and recovery activities, in particular the El Segundo blue butterfly and the seacliff buckwheat host plant. The Air Force will ensure that all measures, terms, and conditions included in the final Biological Opinion for the project will be implemented to protect listed species and habitat, minimize project impacts, and compensate for unavoidable project impacts. Proposed minimization and mitigation measures to protect the El Segundo blue butterfly, California least tern, Western snowy plover, and California red-legged frog are included in the negative determination. Special status marine mammals protected under the Marine Mammal Protection Act may be present under the Falcon 9 launch path, recovery corridor, and first stage landing path. To protect these marine mammals, the Falcon 9 program is subject to the protective measures described in the Letter of Authorization to the Air Force issued by the National Marine Fisheries Service for missile and rocket launches at Vandenberg AFB during the March 26, 2014 to March 26, 2019 time period. Proposed minimization and mitigation measures to protect the Southern sea otter, Pacific harbor seal, California sea lion, Stellar sea lion, and Northern elephant seal are included in the negative determination. The Air Force concluded that with the protective measures required by the ESA and the MMPA, the proposed Falcon 9 project will not adversely affect listed terrestrial or marine species or their habitats.

The Air Force states that all launch programs at Vandenberg AFB are required to establish debris impact corridors as an element of a program's safety review in case of a launch anomaly that requires destructive flight termination. Because of the launch trajectory and the Falcon 9 first stage returning to the SLC-4W landing pad, the Air Force may require closure of Surf Beach and Ocean Park to ensure public safety during a launch or landing anomaly. For typical rocket launches from South Vandenberg AFB, road blocks are placed at the intersection of Ocean Boulevard and 13th Street approximately three hours prior to a launch to close access to the beach. Approximately two hours after completion of a successful launch and landing program,

access to Surf Beach and Ocean Park will reopen. The proposed temporary closure is consistent with past and current launch activities at South Vandenberg AFB and will not create adverse effects on public access and recreation. Portions of the proposed temporary scaffolding and panels to be installed on the west side of the permanent concrete landing pad may be visible from the shoreline and offshore waters, but any impact on scenic resources would be less than significant given the four-week-long time period of panel installation.

In conclusion, the Commission staff **agrees** that the proposed permanent and temporary modifications to SLC-4W, and the one-time Dragon in-flight abort test and Falcon 9 first stage landing at SLC-4W, will not adversely affect coastal zone resources. We therefore **concur** with your negative determination made pursuant to 15 CFR 930.35 of the NOAA implementing regulations. Please contact Larry Simon at (415) 904-5288 should you have any questions regarding this matter.

Sincerely,

(for) CHARLES LESTER
Executive Director

cc: CCC – South Central Coast District

DEPARTMENT OF THE AIR FORCE
30TH SPACE WING (AFSPC)

JUL 1 6 2015

Beatrice L. Kephart
30 CES/CEI
1028 Iceland Avenue
Vandenberg AFB CA 93437-6010

Mr. Larry Simón
Federal Consistency Supervisor
California Coastal Commission
45 Fremont Street, Suites 1900 & 2000
San Francisco CA 94105-2219

Dear Mr. Simón

Under the Federal Coastal Zone Management Act (CZMA) of 1972, as amended, Section 307c(1), 15 CFR Part 930, and the enforceable policies of the California Coastal Act (CCA), the U.S. Air Force (Air Force) at Vandenberg Air Force Base (VAFB) has determined that Space Exploration Technologies Corporation's (SpaceX's) recurring Falcon 9 first stage boost-back and landing at Space Launch Complex (SLC) 4 West (4W) and on a barge specifically designed for the landing and located at least 31 miles (50 km) offshore of VAFB will not adversely affect coastal uses or resources because measures will be implemented to prevent, minimize and mitigate impacts. Therefore, the proposed actions do not require a consistency determination. The Air Force respectfully requests California Coastal Commission (CCC) concurrence on this Negative Determination.

PROJECT DESCRIPTION

SpaceX proposes recurring Falcon 9 first stage booster landing on the SLC-4W pad at VAFB up to six times per year. As a contingency action to landing the Falcon 9 first stage at SLC-4W, SpaceX proposes to return the Falcon 9 first stage booster to a barge. The barge is specifically designed to be used as a first stage landing platform and will be located at least 31 miles (50 km) off VAFB's shore. The contingency landing location would be used if there are critical assets on VAFB that would not permit first stage over-flight. For Range safety analysis to verify stage landing performance it is important that the barge landing trajectory be the same as land landing. The contingency landing location is the furthest from the coastline that SpaceX is able to use to maintain the same boost-back trajectory as for a SLC-4W land landing.

The maneuvering and landing process previously described in Negative Determination ND-0035-14 for a pad landing would be the same for a barge landing. Prior to a barge landing, VAFB will issue a notice to mariners and a notice to airmen.

Three vessels would be required for a barge landing:

a. Barge/Landing Platform – approximately 300 feet (ft) long and 150 ft wide;

b. Support Vessel – approximately 165 ft long research vessel; and,

c. Ocean Tug – 120 ft long open water commercial tug.

The support vessels would originate from Long Beach Harbor and be positioned to support contingency landings. The tug and support vessel would be staged just outside of the landing location.

SpaceX has twice attempted barge landings off Florida's coast. Both attempts were unsuccessful and resulted in the first stage impacting the barge and exploding. If a barge landing attempt is unsuccessful, the first stage would explode upon barge impact. A system safety analysis was performed related to first stage recovery operations. This analysis concentrated on safety hazards related to unsuccessful first stage landings. The explosive equivalence of the first stage with maximum fuel and oxidizer is 503 pounds of trinitrotoluene (TNT). This amount of TNT is capable of generating a maximum projectile range of 1,250 ft. from the point of impact.

SpaceX has experience performing recovery operations after unsuccessful Falcon 9 first stage landing attempts. This experience, in addition to the debris catalog that identifies all floating debris, indicates that after an unsuccessful barge landing approximately 25 pieces of debris will remain floating. The surface area potentially impacted with debris would be less than 114 acres (0.46 km2), and almost all debris would be recovered. All other debris would sink to the bottom of the ocean.

These 25 pieces of floating debris are primarily made up of Carbon Over Pressure Vessels, the LOX fill line and carbon fiber constructed landing legs. Following previous unsuccessful landing attempts SpaceX has successfully recovered all of these floating items. An unsuccessful barge landing off VAFB's coast would result in a very small debris field, making recovery of debris relatively straightforward and efficient. All debris recovered offshore would be transported back to Long Beach Harbor.

Upon impact with the landing barge, the first stage would contain at most 400 gallons of RP-1 on board. If the landing is unsuccessful, most of this fuel would be consumed during the subsequent explosion; residual fuel (estimated to be between 50 and 150 gallons) would be released onto the barge deck at the impact location. Final volumes of fuel remaining in the first stage upon landing may vary, but we anticipate they will be below the high range estimations.

Very light oils, including RP-1, are highly volatile, which means they evaporate quickly when exposed to the air and are usually completely dissipated within 1–2 days after a spill. Following a spill clean-up is usually not necessary or possible with spills of very light oil, particularly with such a small quantity of oil. Therefore, if any RP-1 is released directly into the ocean no attempt would be made to boom or recover RP-1. Any RP-1 remaining on the barge deck from an unsuccessful landing would be recovered, contained and handled per federal, state and local agency requirements.

During descent when the first-stage booster is supersonic, a sonic boom (overpressure of high energy impulsive sound) would be generated. The overpressure would be directed at the ocean surface no less than 31 miles (50 km) off VAFB's coast. A boost-back SLC-4W landing noise analysis determined sonic overpressures would reach as high as 2.0 pounds per square foot (psf) approximately 6 miles (3.7 km) south of SLC-4 and within VAFB's boundary. The SLC-4W pad-based landing

overpressure modeling was roughly extrapolated to show potential noise impacts for landing 31 miles (50 km) west of VAFB. This extrapolation suggests that the maximum overpressure impacting land during a barge or water landing would be 0.4 psf (Figure 1). The Northern Channel Islands and areas of mainland California may experience a sonic boom of 0.2 psf.

Engine noise produced during Falcon 9 first stage barge landing would be similar to the sonic boom intensity estimation. Pad landing data extrapolation suggests that engine noise would not be heard on land (Figure 2).

The Air Force has determined that the proposed actions, as described above, would occur outside the coastal zone. As defined in Section 304 of the Act, the term "coastal zone" does not include "lands the use of which is by law subject solely to the discretion of or which is held in trust by the Federal government." SLC-4W is within the boundaries of VAFB and is wholly owned and operated by the Department of Defense, and therefore is excluded from the coastal zone. In addition, the barge landing site would be at least 29 miles (47 km) beyond the 3 nm (3.5 miles [5.6 km]) seaward limit of the California Coastal Zone.

Although the Air Force has determined that the proposed actions will not significantly impact natural resources, access to the coast, or coastal scenic and visual qualities, we recognize that actions outside the coastal zone may affect natural resources and public access along the coast and therefore are subject to the provisions of the CZMA and CCA.

In October of 2014 the California Coastal Commission reviewed and concurred with Negative Determination ND-0035-14 (SpaceX Dragon In-Flight Abort Test and Falcon 9 First Stage Landing at Space Launch Complex-4 West, at Vandenberg Air Force Base, Santa Barbara County). This ND included the following elements to support Falcon 9 first stage booster landing as part of the In Flight Abort Test:

a. Constructing a SLC-4W 300-foot diameter, 1.6 acre concrete landing pad;

b. Realigning and widening sections of the existing service and access roads connecting SLC-4W and 4 East (4E) to accommodate transferring the Falcon 9 first stage from the SLC-4W landing pad to the SLC-4E hanger;

c. Installing ground-based communication, tracking, and video equipment, and three or four remote-controlled water cannons for firefighting capability;

d. Collecting and diversifying all storm water and/or firefighting runoff from the landing pad to an infiltration basin designed according to the California State Water Resources Control Board construction general permit; and,

e. A one-time Falcon 9 first stage landing at SLC-4W.

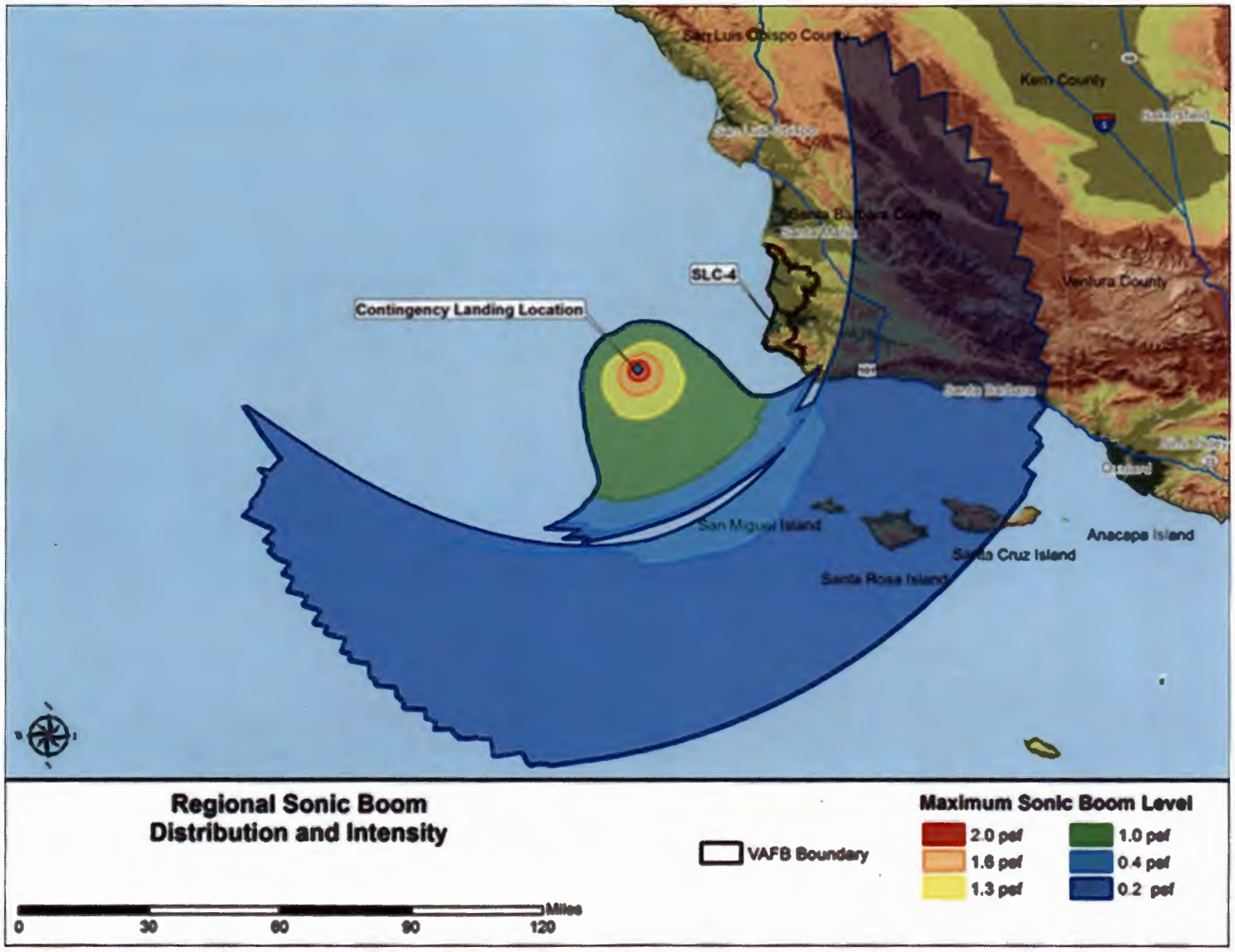

Figure 1. Hypothetical Sonic Boom Overpressure for Contingency Actions of Barge or Water Landing 31 miles (50 km) Offshore of VAFB

Figure 2. Approximate Regional Landing Noise Intensity Map for Barge Landing 31 miles (50 km) off of VAFB

The proposed recurring boost-back and landing of the Falcon 9 first stage would not affect any coastal use or resource to an extent not already considered (ND-0035-14). The barge landing site would be at least 29 miles (47 km) beyond the 3 nm (3.5 miles [5.6 km]) seaward limit of the California Coastal Zone and would not affect the scenic and visual qualities of coastal areas; terrestrial resources, including environmentally sensitive habitat areas; or agricultural resources.

Natural Resources

The boost-back and landing of the Falcon 9 first stage would produce a visual disturbance, landing engine noise and a pressure wave (sonic boom) that may cause short-term behavior disruption and may elicit a startle response, resulting in temporary disturbances to federally listed species, in particular the California red-legged frog (*Rana draytonii*), western snowy plover (*Charadrius nivosus*), California least tern (*Sterna antillarum browni*), southern sea otter (*Enhydra lutris nereis*) and marine mammals protected under the Marine Mammal Protection Act (MMPA). These disturbances would be short in duration and normal activities would be expected to resume quickly once the disturbance has ended.

Given a fuel spill would only occur following an explosion due to unsuccessful barge landing attempt, it is unlikely that marine mammals, seabirds, sea turtles, and fish would remain in the immediate area and be subjected to any spill. Avoidance as a behavioral reaction would not be expected to have long term effects and would therefore not be present when an animal returned to the coastal zone. Any release of RP-1 into the ocean no less than 31 miles (50 km) from shore would not affect the California Coastal Zone since the spill should evaporate before reaching the coastal zone. Therefore, no adverse effects to the coastal zone or coastal resources, as defined by the CZMA and CCA, are anticipated.

Endangered Species Act (ESA) Section 7 informal consultations are currently underway with the U.S. Fish and Wildlife Service and National Marine Fisheries Service (NMFS). The Air Force determined that effects to federally listed species from the proposed actions are insignificant and discountable.

To protect marine mammals, the Falcon 9 program is subject to the protective measures described in the Letter of Authorization (LOA) to the Air Force issued by the National Marine Fisheries Service for missile and rocket launches at VAFB during the March 26, 2014 to March 26, 2019 time period. In addition, SpaceX is applying for an Incidental Harassment Authorization for Level B harassment to marine mammals from project related activities that are not currently included in the VAFB LOA (e.g., debris from unsuccessful barge landing). Proposed minimization and mitigation measures to protect marine mammals will be implemented when applicable. The Air Force concludes that with the protective measures required by the MMPA, the proposed first stage landing would result in only temporary Level B harassment to marine mammal species.

The barge landing site offshore of VAFB is within Essential Fish Habitat (EFH) designated for Pacific Coast Groundfish and Coastal Pelagic Species. The Point Conception EFH Conservation Area, which is restricted to specific types of fishing to minimize the adverse effects of fishing, is located approximately 2.5 miles southwest of the barge landing site. Habitat Areas of Particular Concern have been designated for Pacific Groundfish, which include all waters, substrates, and associated biological communities falling within estuaries, canopy kelp or kelp forests, seagrasses, rocky reefs, and other habitat areas of interest. No kelp forests are located in the landing site vicinity. Seagrass beds are located along the coastline or within coastal estuaries and are not near the barge landing site. The nearest rocky substrates are located approximately 10 miles north-northeast of the barge landing site. Since the area that would be impacted by falling debris is very small, the likelihood of significant impacts to EFH for Pacific Groundfish and Coastal Pelagic Species is very low. We anticipate denser debris that

would not float on the surface would sink relatively quickly. They are composed of inert materials that would not change the characteristics of bottom substrate EFH. The rate of deposition would vary with the type of debris; however, none is so dense or large that benthic habitat would be degraded. Also, the area that would be impacted by sinking debris would be very small. The fuel (RP-1) used in the first stage is highly volatile and would evaporate quickly when exposed to the air. This type of fuel usually dissipates completely within 1-2 days after a spill. The Air Force determined that the proposed actions will only temporarily and no more than minimally affect EFH and requested NMFS concurrence.

Public Access

Access to the coast at Wall and Surf Beaches would already be restricted during launches of the Falcon 9 due to security. The addition of the boost-back and landing procedure would not significantly lengthen the closure period. At program maturity, up to six launches per year may occur, with coastal access restricted for a short period of time (5 to 8 hours total). We do not anticipate adverse effects to the coastal zone, as defined by the CZMA and CCA.

The U.S. Coast Guard would issue a Local Notice to Mariners that defines a Public Ship Avoidance Area around the barge landing location. The three vessels would operate within established shipping and boating routes within the coastal zone while in route between the landing site and Long Beach Harbor. For recreational vessel encounters, standard rules of navigation and right-of-way would be followed. Recreational boating would only be temporarily delayed, typically several hours, during barge, tug and support vessels transit, and during debris recovery.

DETERMINATION

The Air Force determined that recurring boost-back of the Falcon 9 first stage and landing at SLC-4W and on a barge at least 31 miles (50 km) offshore of VAFB will not adversely affect natural resources or access to the coastal zone, and project activities would result in Level B harassment only to marine mammals. The Falcon 9 first stage recurring landing at SLC-4W will not generate new or additional coastal resources impacts not previously examined by the CCC in ND-0035-14 for a one-time Falcon 9 first stage landing at SLC-4W. In addition, the Air Force has determined that measures to prevent, minimize and/or mitigate potential effects of barge landing 31 miles (50 km) offshore of VAFB, incorporated into the project, would reduce potential coastal effects to within acceptable levels. Therefore, the Air Force seeks CCC concurrence with this Negative Determination.

If you need additional information or have questions, please call me at (805) 605-7924 or email me: beatrice.kephart@us.af.mil . You can also call Samantha Kaisersatt at (805) 605-0392 or email her: samantha.kaisersatt@us.af.mil .

Sincerely

BEATRICE L. KEPHART
Chief, Installation Management Flight

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August 31, 2015

Beatrice L. Kephart
Chief Installation Management Flight
Department of the Air Force
ATTN: Samantha Kaisersatt
1028 Iceland Avenue
Vandenberg AFB, CA 93437-6010

Subject: Negative Determination ND-0027-15 (Recurring Falcon 9 rocket launches from SLC-4E and first stage boost-back landings at SLC-4W or an offshore barge, Vandenberg Air Force Base, Santa Barbara Co.)

Dear Ms. Kephart:

The Coastal Commission staff has reviewed the above-referenced project at Vandenberg Air Force Base (AFB). The Air Force proposes to oversee the Space Exploration Technologies Corporation's (SpaceX) program of recurring Falcon 9 rocket launches from Space Launch Complex – 4 East (SLC-4E) and first-stage boost-back and landings at SLC – 4 West (SLC-4W) or on a barge offshore of Vandenberg AFB. The proposed launch and landing program will be integrated into the Vandenberg AFB range infrastructure and will comply with all range, safety, and communications requirements. The Air Force will monitor and maintain oversight of the launch process and communications with the Falcon 9 rocket while on the ground, in flight, and during first-stage boost-back and landing at either SLC-4W or the offshore barge.

The Executive Director previously concurred with a negative determination from the Air Force (ND-055-10) in November 2010 for modifications to SLC-4E to support the Falcon 9 and Falcon 9 Heavy launch vehicle programs at Vandenberg AFB. In October 2013 the Executive Director concurred with a negative determination from the Air Force (ND-0035-14) for a single launch of the Falcon 9 rocket from SLC-4E, the in-flight abort test of the Dragon spacecraft capsule and recovery operations approximately 1.5 miles off the Vandenberg AFB coast, and the Falcon 9 first stage boost-back and landing at SLC-4W. ND-0035-14 also included construction of a 1.6-acre concrete landing pad at SLC-4W; a temporary 5.7-acre area of flat panels west of the landing pad (installed two weeks prior to a launch and removed two weeks after launch) to facilitate radar sensor operations during first-stage landings; realignment of existing service and access roads; installation of ground-based communications equipment; and improvements to stormwater and firefighting runoff collection infrastructure at SLC-4W. The construction activity and test flight operations proposed under ND-0035-14 have yet to commence.

The Air Force now proposes to oversee up to six SpaceX Falcon 9 launches per year from SLC-4E and associated first-stage landings at SLC-4W or on the offshore barge. The proposed launch, first-stage maneuvering, and first-stage landing process previously concurred with in ND-0035-14 for a landing at SLC-4W would be the same for recurring launches and for the barge landing alternative. The Air Force states that as a contingency action to landing the Falcon 9 first-stage booster at SLC-4W, SpaceX proposes to potentially return the first-stage booster to an offshore barge (approximately 300 feet long and 100 feet wide), specifically designed as a first-stage landing platform and located at least 31 miles offshore of Vandenberg AFB. This contingency landing location would be used if there are critical assets on Vandenberg AFB that would not permit first-stage over-flight and landing at SLC-4W. The Air Force states that for range safety analysis to verify first-stage landing performance, it is important that the barge landing trajectory be the same as for the SLC-4W landing. The barge location is the furthest from the coastline that can be used to maintain the same boost-back trajectory as for a SLC-4W landing.

The proposed offshore barge landing is the only element of the overall Falcon 9 program that was not analyzed and concurred with by the Executive Director under the previous negative determinations for a Falcon 9 launch and upland landing of the first-stage booster. The landing barge, an ocean tug, and a support vessel would originate from Long Beach Harbor, and after a successful landing the first stage would be secured onto the barge and transported to Long Beach Harbor for off-loading and subsequent transport to a SpaceX testing facility in McGregor, Texas. To protect marine mammals, the Falcon 9 program, including the newly-proposed offshore barge landings, is subject to the protective measures described in the Letter of Authorization to the Air Force issued by the National Marine Fisheries Service for missile and rocket launches at Vandenberg AFB during the March 26, 2014 to March 26, 2019 time period. The Air Force has also received concurrence from the U.S. Fish and Wildlife Service and the National Marine Fisheries Service that the proposed offshore barge landings include all necessary avoidance and protective measures to protect federally listed species. In addition, no kelp forests or seagrass beds are at or near the proposed offshore barge landing site, and the nearest rocky substrates are located approximately ten miles north-northeast of the barge landing site.

The Air Force reports that the two attempts at a Falcon 9 first-stage barge landing offshore of the Kennedy Space Center in Florida were unsuccessful, resulting in the first-stage impacting the barge and exploding. Should a Falcon 9 first-stage barge landing at the offshore Vandenberg location be similarly unsuccessful, the Air Force states that SpaceX will implement recovery operations at the barge and adjacent ocean waters. Based on the two Florida events, almost all of the floating debris would be recovered from the ocean surface and the remaining dense, inert debris would sink to the ocean floor, which is approximately 4,000 feet below the ocean surface at the proposed barge location. Any release of fuel from a first-stage booster explosion at the barge would evaporate quickly after exposed to the air and would usually completely dissipate after one to two days. Given that the landing barge would be located no closer than 31 miles offshore of Vandenberg AFB, well seaward of the coastal zone boundary, the accidental destruction of the first-stage booster at this location would not affect coastal zone resources.

All launch programs at Vandenberg AFB are required to establish debris impact corridors as an element of a program's safety review in case of a launch anomaly that requires destructive flight termination. Because of the launch trajectory and the Falcon 9 first stage returning to the SLC-4W landing pad or the offshore landing barge, the Air Force may require closure of Surf Beach and Ocean Park to ensure public safety during a launch or landing anomaly. For typical rocket launches from South Vandenberg AFB, roadblocks are placed at the intersection of Ocean Boulevard and 13th Street approximately three hours prior to a launch to close access to the beach. Approximately two hours after completion of a successful launch and landing program, access to Surf Beach and Ocean Park will reopen. The proposed temporary closure is consistent with past and current launch activities at South Vandenberg AFB and will not create adverse effects on public access and recreation. In addition, the U.S. Coast Guard would issue a Local Notice to Mariners that defines a Public Ship Avoidance Area around the barge landing location. Recreational boating and fishing would only be temporarily interrupted during offshore barge landing or debris recovery operations.

The Air Force also states in its negative determination that if SpaceX's next two consecutive barge landing attempts (and the resultant explosion and sinking of debris into the ocean) off the California coast are unsuccessful, the Air Force will inform the Commission's Executive Director about the status of the program and whether it will continue as proposed or be modified in some manner. In conclusion, the Commission staff **agrees** that the proposed recurring Falcon 9 launch and first-stage landing at SLC-4E and SLC-4W, respectively, at Vandenberg AFB, and the first-stage landing on a barge located 31 miles offshore of Vandenberg AFB, will not adversely affect coastal zone resources. The proposed launch and inland landing operations are similar to those concurred with by the Executive Director in ND-0035-14. We therefore **concur** with your negative determination made pursuant to 15 CFR 930.35 of the NOAA implementing regulations. Please contact Larry Simon at (415) 904-5288 should you have any questions regarding this matter.

Sincerely,

CHARLES LESTER
Executive Director

cc: CCC – South Central Coast District

APPENDIX C: State Historic Preservation Office Consultation

DEPARTMENT OF THE AIR FORCE
30TH SPACE WING (AFSPC)

SEP 18 2014

Lieutenant Colonel Deron L. Frailie
Commander, 30th Civil Engineer Squadron
1172 Iceland Ave
Vandenberg AFB CA 93437-6012

Dr. Carol Roland-Nawi
State Historic Preservation Officer
Department of Parks and Recreation
Office of Historic Preservation
P.O. Box 942896
Sacramento CA 94296-0001

Dear Dr. Roland-Nawi

The 30th Space Wing of the United States Air Force, Vandenberg Air Force Base (VAFB), proposes to permit the Space Exploration Technologies Corporation (SpaceX) to lease and renovate Space Launch Complex 4 West (SLC-4W) for the purposes of testing and operating its Falcon Launch Vehicle Program (Atch 1 and Atch 2). The last launch from SLC-4W was a Titan II in October 2003. In 2005, an Environmental Assessment was completed for the Demolition and Abandonment of Atlas and Titan Facilities at VAFB. Currently, SpaceX leases and operates the eastern part of the SLC-4 complex, SLC-4E, to assemble and launch the Falcon 9. SpaceX would use SLC-4W as the 'boost-back' site, meaning the Falcon 9 that launches from SLC-4E would, once the second stage separates and fires, have the first stage turn around, reverse course, and execute a controlled landing at SLC-4W. Program success would facilitate refurbishment and re-use of Stage 1 boosters and greatly reduce overall program costs.

§800.3 Initiation of the Section 106 Process

VAFB determined that *Re-Use of Space Launch Complex 4 West* is an undertaking subject to compliance with Section 106 of the National Historic Preservation Act of 1966, as amended, and will comply with Section 106 using the implementing regulations [36 CFR Part 800]. Per §800.3(c-f), VAFB identified and is involving appropriate consulting parties: the California State Historic Preservation Officer (SHPO) and the federally-recognized Santa Ynez Band of Chumash Indians. With this letter and attachments, VAFB is initiating consultation with the SHPO.

§800.4 Identification of Historic Properties

The entire area encompassed by the SLC-4W security fence is considered the area of direct impacts (ADI) in order to support maintenance of the grounds, security fence, roads, and buildings; to support fire suppression in the event of a fire; and to support renovation of launch-related facilities. The primary feature to renovating the launch facility includes converting the Titan II launch pad into a Falcon 9 landing pad. This would entail removing the mobile service tower and, in its place, constructing a 300-foot-diameter landing pad. A V-ditch would encircle the landing pad

to capture water run-off and divert it to an infiltration basin. An existing access road would be straightened and widened to support rocket transport after landing. Some trenching would be needed to tie proposed fire suppression systems into the existing water main. These specific improvement areas are shown on Attachment 3. One additional component to the boost-back operation is installation of a temporary scaffolding system west of the landing pad approximately one week prior to scheduled landings and removal afterwards. The scaffolding would support a flat surface, needed to enable the first stage to navigate to the landing pad using a global positioning system and radar system. The scaffolding simply sits on the ground surface. The area of potential effects (APE) includes the entirety of the ADI plus, when the ADI overlaps an archaeological site, the APE is expanded to include the entirety of the archaeological site (Atch 4).

At least 15 cultural resources investigations have occurred within a quarter-mile of the APE. These are listed and summarized in Chapter 3 of Attachment 5 (Lebow 2014). An additional survey was completed within the SLC-4W security fence specifically for this undertaking. Methods and results for that effort are described in Chapter 4 of Attachment 5. A reasonable and good-faith effort to identify historic properties within the APE in accordance with 36 CFR 800.4(a)-(d) resulted in the identification of one isolated prehistoric artifact, one prehistoric site complex, and the SLC-4W launch facility (Table 1).

Table 1: Cultural Resources Within the APE

Resource	Resource Type	National Register Eligibility Status
VAFB-ISO-0962	Isolated Prehistoric Artifact	Categorically Ineligible
CA-SBA-0537/1816	Prehistoric Site	Determined Eligible
SLC-4W	Built Environment	Determined Ineligible

By consensus, CA-SBA-537 was determined eligible for the National Register of Historic Places (NRHP) (USAF870302A), as was CA-SBA-1816 (USAF880104A). In 1997, a base-wide survey focusing on buildings and facilities constructed or used during the Cold War was carried out. Based on findings and recommendations from that study and with extensive consultation with the SHPO, VAFB developed a Programmatic Agreement (PA) and a Historic Preservation Plan (HPP) for the management of Cold War Era historic properties. VAFB and the SHPO agreed that none of the built environment features of the SLC-4 complex were eligible for the NRHP. As such, none of the built environment features at SLC-4 were included in the PA and HPP. The reason SLC-4 is not eligible for the NRHP is because it was constructed in 1961 and does not possess exceptional significance, and also because it lacks integrity. Originally constructed as an Atlas Agena launch complex, it was modified to launch Titan rockets, and then suffered extensive damage during a failed Titan launch in April 1986 (Atch 6).

§800.5 Assessment of Adverse Effects

In support of extensive reconstruction activities that followed the Titan disaster in 1986, an inordinate amount of data recovery excavations were carried out at the CA-SBA-0537/1816 site complex. More recently, to support demolition of launch structures at SLC-4W, Applied EarthWorks, Inc., conducted subsurface testing within the security fence to assess potential project effects (Lebow et al. 2005). The 20 shovel test pits (STPs) excavated within the SLC-4W fence line

encountered mixed soils containing modern material; 10 of the STPs recovered only 29 pieces of flaked-stone debitage from undisturbed sediments. One test excavation unit recovered only 43 flakes. The investigation resulted in a finding that project activities would not adversely affect the site complex. The SHPO concurred (Demolition and Abandonment of Atlas and Titan Facilities on Vandenberg AFB, USAF050912A, SHPO concurrence letter dated 17 Dec 2005). Additional detail regarding the archaeological deposits within the fence line and the assessment of no adverse effect is provided in Chapter 5 of Attachment 5. Additionally, Figure 4-1 and Figure 4-2 in Attachment 5 illustrate how heavily the natural landscape was modified to create SLC-4W.

Having applied the criteria of adverse effect to one historic property in accordance with 36 CFR 800.5(a)-(d), VAFB requests SHPO concurrence with the following determinations:

a. The APE for *Re-Use of Space Launch Complex 4 West* is adequately delineated, and

b. The proposed undertaking would not alter, directly or indirectly, any of the characteristics of CA-SBA-0537/1816 that qualify the historic property for inclusion in the NRHP.

Documentation supporting these findings is attached. An Environmental Assessment (EA) is being prepared to satisfy the National Environmental Policy Act (NEPA). The EA will be circulated within the region, and copies will be sent to many local and regional regulators. If concerns are raised about this proposed project, VAFB will contact the SHPO as needed. Consultation with the Santa Ynez Band of Chumash Indians (Tribe) will continue for the life of this project. Any serious concerns raised by the Tribe will be forwarded to the SHPO.

Pending concurrence on the above determinations by the SHPO, VAFB's Section 106 finding for the *Re-Use of Space Launch Complex 4 West* is no adverse effect to historic properties. If there is no objection to this finding by the SHPO, VAFB has fulfilled its Section 106 responsibilities for the undertaking and no further consultation is required. If the SHPO objects to any of these findings we understand further consultation would be necessary. If project implementation results in a discovery during construction, VAFB will reopen Section 106 consultation. If you have any questions or require additional information, please contact Christopher Ryan at (805) 605-0748 or via e-mail at christopher.ryan.7@us.af.mil. Thank you for your assistance with this undertaking.

Sincerely

DERON L. FRAILIE, Lt Col, USAF
Commander

6 Attachments:
1. Project Location
2. Project Vicinity
3. Area of Direct Impacts
4. Area of Potential Effects
5. Archaeological Survey Report
6. Launch Anomaly at SLC-4

Summary of Excavation Units at CA-SBA-537/1816

Unit	Maximum Depth (cm)	Maximum Depth of Cultural Remains (cm)	Total Material Summary (number/type)[a]	Total Volume (m^3)	Depth to Intact Sediments (cm)	Material from Intact Sediments
STP 6	100	100	6 DEB	0.196	0	6 DEB
STP 9	100	100	15 DEB, 1 BON	0.196	80	4 DEB
STP 10	100	100	18 DEB	0.196	40	13 DEB
STP 11	100	100	6 DEB	0.196	50	3 DEB
STP 14	100	80	3 DEB	0.196	60	3 DEB
TEU 1	150	150	43 DEB	1.505	70	43 DEB

a - BON = Bone; DEB = Debitage; SHL = Shell.

N

SLC 4 West

SLC 4 East

CA-SBA-0537

CA-SBA-1816

14

1

11

10

9

6

ATTACHMENT 4
AREA OF POTENTIAL EFFECTS

Re-Use of Space Launch Complex 4 West
Vandenberg Air Force Base
Santa Barbara County, California

Area of Potential Effects
STPs - Positive & Intact
STPs - Negative &/or Mixed
Landing Pad
Facilities
Paved Roads

0 200 400
Feet

LIDAR Hillshade, 2005
(Light Imaging Detection and Ranging)

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DEPARTMENT OF PARKS AND RECREATION
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October 14, 2014

Reply in Reference To: USAF_2014_0924_001

Deron L. Frailie, Lt Col, USAF
Commander, 30th Civil Engineer Squadron
1172 Iceland Ave
Vandenberg AFB, California 93437-6012

Re: Requesting Consultation from the State Historic Preservation Officer (SHPO) on the Lease and Renovation of Space Launch Complex 4 West Undertaking for the Falcon Launch Vehicle Program, Vandenberg Air Force Base, Santa Barbara County, California

Dear Lt Col Frailie:

Thank you for your September 18, 2014 letter initiating SHPO consultation for the above undertaking. The 30th Space Wing of the United States Air Force, Vandenberg Air Force Base (VAFB) is consulting with the SHPO to comply with Section 106 of the National Historic Preservation Act of 1966 (16 U.S.C. 470f), as amended, and its implementing regulations 36 CFR 800. Your letter requests SHPO concurrence on VAFB's determination and documentation of the area of potential effects (APE) (36 CFR §800.4(a)), and finding of no adverse effect to historic properties (36 CFR §800.5(b)) as a result of this undertaking.

The proposed undertaking involves VAFB permitting the Space Exploration Technologies Corporation (SpaceX) to lease and renovate Space Launch Complex 4 West (SLC-4W) for the purposes of testing and operating its Falcon Launch Vehicle Program. SpaceX would use SLC-4W as the "boost-back" site, meaning the Falcon 9 that launches from SLC-4E would, once the second stage separates and fires, have the first stage turn around, reverse course, and execute a controlled landing at SLC-4W. Most of the in-flight abort test occurs at high altitude over the Pacific Ocean. Consequently, only the relanding presents any potential cultural resources concerns because the abort test and the boost-back will occur over the ocean.

VAFB has determined and documented the APE (36 CFR §800.4(a)(1)) as the entirety of the area of direct impact (ADI), where the ADI overlaps an archaeological site, the APE was expanded to include the entirety of the archaeological site. The ADI includes the entire area encompassed by the SLC-4W security fence in order to support maintenance of the grounds, security fence, roads, and buildings; to support fire suppression in the event of a fire; and to support renovation of launch-related facilities. Further description of the ADI and APE are located on pages 1 and 2 of your letter and illustrated in attachments 1 through 4. I find VAFB's determination and documentation of the APE to be sufficient (36 CFR §800.4(a)(1)).

Supporting documentation (36 CFR §800.11(a)) submitted with your letter includes the following six attachments:

- Attachment 1: Project Location Map
- Attachment 2: Project Vicinity Map
- Attachment 3: ADI Map
- Attachment 4: APE Map
- Attachment 5: *Archaeological Survey of Space Launch Complex 4W for Landing of the Falcon 9 First Stage Vandenberg Air Force Base, Santa Barbara County, California* (Lebow 2014)
- Attachment 6: Launch Anomaly at SLC-4 Illustration

The VAFB's efforts to identify historic properties within the APE (36 CFR §800.4(b)(1)) included a record search of the APE, including a 0.25 mile buffer around the APE. Results from the record search identified previous cultural resource studies within the APE including a three-phase inventory and evaluation of Cold War properties on VAFB and several cultural resource studies of portions of the APE for prior undertakings. The record search also revealed one previously recorded archaeological resource, CA-SBA-537, located within the APE and partially located within the ADI. Archaeological resource, CA-SBA-1816, is located adjacent to the APE and within CA-SBA-537, and forms a complex designated by VAFB as CA-SBA-537/1816. CA-SBA-537 is recorded as a prehistoric resource processing site and CA-SBA-1816 is recorded as a short-term residence/resource processing site. Both resources have been previously archaeologically tested and found to contain data important to understanding prehistory and determined by VAFB to be eligible for listing on the National Register of Historic Places (NRHP) under Criterion D. VAFB previously consulted with the SHPO on both resources' determination of eligibility and received SHPO concurrence of both resources' eligibility for inclusion on the NRHP under Criterion D. Additionally, the SLC-4W is a Cold War-era resource, and in previous consultation with the SHPO, VAFB determined that SLC-4W is ineligible for listing on the NRHP.

The record search also revealed that extensive data recovery excavations of CA-SBA-537/1816 were completed for prior undertakings that included repairs and restoration of SLC-4W. The testing concluded that areas of CA-SBA-537/1816 that extend into SLC-4W, and within the current ADI, have poor integrity and only encompass a low-density and low-diversity deposit. One previous excavation in particular tested CA-SBA-537/1816 to determine whether demolition of selected facilities at SLC-4W would adversely affect the site. The excavation only identified a very sparse cultural deposit within the demolition APE and the VAFB determined that the demolition would not adversely affect the site's significant qualities that make it eligible for inclusion in the NRHP and the SHPO concurred with this finding.

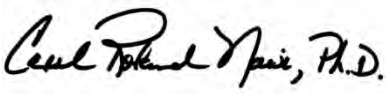
Additional identification efforts included an archaeological survey of areas within the APE that had not been previously surveyed. One isolated prehistoric Monterey chert flaked tool was identified and no new archaeological sites were identified as a result of the survey.

The VAFB has a long standing consultation relationship with the Santa Ynez Band of Chumash Indians (SYBCI) and has initiated consultation as part of their gathering of information pursuant to 36 CFR §800.3(f) to assist in identifying properties which may be of religious and cultural significance and may be eligible for listing in the National Register of Historic Places (NRHP) (36 CFR §§800.4(a)(4) and 800.4(b)). Your letter indicates that consultation with the SYBCI will continue for the life of this project and any serious concerns raised by the Tribe will be forward to our office. As the date of this letter, the VAFB has not received any comments/responses from SYBCI (Christopher Ryan, email, 14 October 2014).

The VAFB has applied the criteria of adverse effect (36 CFR §800.5) and has determined that the proposed undertaking will not alter, directly or indirectly, any of the characteristics of CA-SBA-537/1816 that qualify the historic property for inclusion in the NRHP. Based on VAFB's level of effort, they have determined a finding of no adverse effect to historic properties (36 CFR §800.5(b)) as a result of this undertaking. I have reviewed the supporting documentation and concur with your finding of no adverse effect to historic properties as a result of this undertaking.

Thank you for seeking my comments and considering historic properties as part of your undertaking. Please be advised that under certain circumstances, such as post-review discoveries or a change in the undertaking description, you may have future responsibilities for this undertaking under 36 CFR Part 800. If you require further information, please contact Alicia Perez of my staff at 916-445-7020 or at Alicia.Perez@parks.ca.gov.

Sincerely,



Carol Roland-Nawi, Ph.D.
State Historic Preservation Officer

APPENDIX D: United States Fish and Wildlife Service Consultation

DEPARTMENT OF THE AIR FORCE
30TH SPACE WING (AFSPC)

JUL 22 2014

Beatrice L. Kephart
30 CES/CEI
1028 Iceland Avenue
Vandenberg AFB CA 93437-6010

Stephen P. Henry
U.S. Fish and Wildlife Service
2493 Portola Road, Suite B
Ventura CA 93003

Dear Mr. Henry

In accordance with section 7 of the Endangered Species Act of 1973, Vandenberg Air Force Base (VAFB) requests formal consultation on an operational check of the boost-back and the first stage landing of the Falcon 9 vehicle at SLC-4W as well as an in-flight abort test of the Dragon capsule.

We request "take" as a result of our determination that this project "may affect, and is likely to adversely affect" California red-legged frog (*Rana draytonii*), El Segundo blue butterfly (*Euphilotes battoides allyni)*, California least tern (*Sternula antillarum browni*), and the western snowy plover (*Charadrius nivosus*), although extensive avoidance and monitoring measures will minimize disturbance to these species. We are also requesting concurrence on our "may effect, but not likely to adversely affect" determination for the southern sea otter (*Enhydra lutris nereis).*

Enclosed is our biological assessment with the project description and effects of project activities. As always, we would appreciate the opportunity to review the draft Biological Opinion for this project before your office finalizes it. Additionally, we request formal notification that all necessary materials and information have been received in support of a 135-day consultation.

Thank you for your assistance. Please contact me at (805) 605-7924 or Samantha Kaisersatt at (805) 605-0392 if you have any questions.

Sincerely

BEATRICE L. KEPHART
Chief, Installation Management Flight

Attachment:
Biological Assessment

Biological Assessment

Boost-back and Landing of the Falcon 9 First Stage at SLC-4 West, and the Dragon in Flight Abort Test, Vandenberg Air Force Base, California

July 2014

Prepared for

Space Exploration Technologies
1 Rocket Road
Hawthorne, CA 90250

and

30th Civil Engineer Squadron
Environmental Assets
1028 Iceland Avenue, Building #11146
Vandenberg AFB, CA 93437-6010

Prepared by

Tetra Tech Inc.
5383 Hollister Ave., Suite 130
Santa Barbara, CA 93111

Table of Contents

1.0 Introduction 1
1.1 Site History 1
2.0 Project Description 2
2.1 SLC-4W Improvements 3
2.2 In-Flight Abort Test 8
2.3 Boost-back and Landing 10
2.4 Summary of Key Project Elements 13
2.5 Minimization and Monitoring Measures 13
2.5.1 El Segundo Blue Butterfly 13
2.5.2 California Least Tern 14
2.5.3 Western Snowy Plover 14
2.5.4 California Red-legged Frog 14
2.5.5 Southern Sea Otter 15
3.0 Status of the Species 15
3.1 El Segundo Blue Butterfly [Federal Endangered Species] 15
3.2 California Red-legged Frog [Federal Threatened Species] 16
3.3 California Least Tern [Federal Endangered Species] 16
3.4 Western Snowy Plover [Federal Threatened Species] 17
3.5 Southern Sea Otter [Federal Threatened Species] 17
4.0 Survey Methods 18
5.0 Survey Results 18
5.1 Vegetation Types 18
5.2 El Segundo Blue Butterfly 19
5.3 California Red-legged Frog 19
5.4 California Least Tern 20
5.5 Western Snowy Plover 20
5.6 Southern Sea Otter 20
6.0 Other Species Considered 21
7.0 Effects of the Proposed Action on Federally Listed Species and Potential Habitat 22
7.1 Effects to El Segundo Blue Butterfly 22
7.2 Effects to California Red-legged Frog 23
7.3 Effects to California Least Tern 25
7.4 Effects to Western Snowy Plover 26

7.5 Effects to Southern Sea Otter 27
8.0 Analysis of Effects of the Proposed Action on Federally Listed Species 28
8.1 El Segundo Blue Butterfly 28
8.2 California Red-legged Frog 29
8.3 California Least Tern 30
8.4 Western Snowy Plover 30
8.5 Southern Sea Otter 30
9.0 Cumulative Effects 30
10.0 Interrelated and Independent Effects 31
11.0 Conclusion 31
12.0 Bibliography 33

List of Figures

Figure 1. Listed Species Occurrence in Project Area 4
Figure 2. Listed Species Occurrence Near SLC-4W 5
Figure 3. Biological Survey Results 6
Figure 4. Extent of Scaffolding Coverage 7
Figure 5. Extent of Overpressure 11
Figure 6. Extent of Overpressure at Vandenberg AFB 12

List of Graphics

Graphic 1. Dragon Abort Test Vehicle 8

List of Tables

Table 1. Acreage of Vegetation Types Found within the Project Site and 30-foot Buffer on Vandenberg AFB 18

Acronyms and Abbreviations

4E	4 East
4W	4 West
AF	Air Force
AFB	Air Force Base
BA	Biological Assessment
CLTE	California least tern
CRLF	California red-legged frog
dBA	A-weighted decibel scale
ESA	Endangered Species Act
ESBB	El Segundo blue butterfly
FR	Federal Register
GIS	Geographic Information System
GPS	Global Positioning System
HIF	horizontal integration facility
km	kilometers
MSRS	ManTech SRS Technologies
PEL	permissible exposure limits
psf	pound per square foot
RP-1	Rocket Propellant
SLC	Space Launch Complex
SRMs	Solid Rocket Motors
SRS	SRS Technologies, Inc.
SpaceX	Space Exploration Technologies
SWFL	Southwestern willow flycatcher
U.S.	United States
USFWS	U.S. Fish and Wildlife Service
UTS	Unarmored threespine stickleback
WSPL	Western snowy plover

1.0 Introduction

The Commercial Space Launch Act of 1984 (Public Law 98-575), as codified at 49 United States (U.S.) Code 70101-70119, declares that it is in the national economic interest of the United States to facilitate the development of commercial launch vehicles and associated services. To do this, the Commercial Space Launch Act allows for the use of underutilized government infrastructure and resources to promote commercialization of space and space technology. The U.S. Air Force (Air Force) provides support to the U.S. Government and commercial entities for low-cost and reliable access to space.

Space Exploration Technologies (SpaceX), currently operating at Space Launch Complex 4 East (SLC-4E), Vandenberg Air Force Base (AFB), California proposes to conduct an operational check of the boost-back and the first stage landing of the Falcon 9 vehicle as well as perform an in-flight abort test of the Dragon capsule. The operational check and abort test would be conducted during the same mission. The mission would be utilized to ensure the viability of upcoming launches and to validate the potential for reutilization of the first stage booster for future missions. To accommodate the landing of the first stage at Vandenberg AFB, SpaceX proposes constructing a 300-foot diameter concrete pad at Space Launch Complex 4 West (SLC-4W), which is located adjacent to the SLC-4E pad currently used for Falcon 9 launches.

SpaceX selected Vandenberg AFB for this action due to the relative proximity to the Pacific Ocean to support Dragon capsule ocean landing requirements. In addition, westerly trajectories are over asset free areas that eliminate risks in the case of mission anomalies.

This Biological Assessment (BA) has been prepared to support a formal section 7 consultation with the U.S. Fish and Wildlife Service (USFWS) under the Endangered Species Act, 16 U.S.C. §§ 1531-1544 and its implementing regulations, 50 CFR Part 402. This BA specifically addresses improvements to SLC-4W, the first stage landing of the Falcon 9 vehicle, the in-flight abort test, the potential effects of these actions on federally listed species and their habitats, and determines if the species or habitat are likely to be adversely affected by the proposed action. Section 7 consultation regarding the demolition of existing facilities at SLC-4E and launch from SLC-4E has been previously completed (USFWS 2010, USFWS 2011a).

1.1 Site History

SLC-4 was originally constructed to launch Atlas/Agena missiles for the Point Arguello Naval Station. The Air Force assumed responsibility for SLC-4 in 1966 and continued to use the complex for launch programs until it was decommissioned in 2005. During this period, water was required for deluge, wash downs, and facility maintenance and use. Prior to 1988, water used and collected on site was discharged directly into Spring Creek, an ephemeral stream just south of SLC-4. Surface and groundwater within Spring Creek was found to be contaminated as a result of these discharges. In 1988, the Central Coast Regional Water Quality Control Board prohibited the discharge of deluge and wash down water into Spring Creek. The Air Force is using its Installation Restoration Program to clean up the contamination.

Consultation with the USFWS for the Air Force's Titan space launch vehicle program at SLC-4 was completed pursuant to section 7 of the Endangered Species Act (ESA) in 1988 and again in 1996 (USFWS 1988, 1996). The USFWS concurred that activities associated with the Titan program would not jeopardize the continued existence of beach layia (*Layia carnosa*), unarmored threespine stickleback (*Gasterosteus aculeatus williamsoni*), tidewater goby (*Eucyclogobius newberryi*), California red-legged frog [*Rana draytonii* (CRLF)], California brown pelican (*Pelecanus occidentalis californicus*), American peregrine falcon (*Falco peregrinus*

anatum), least Bell's vireo (*Vireo bellii pusillus*), southwestern willow flycatcher (*Empidonax traillii extimus*), bald eagle (*Haliaeetus leucocephalus*), western snowy plover (*Charadrius nivosus*), and southern sea otter (*Enhydra lutris nereis*). The California brown pelican, American peregrine falcon, and bald eagle have subsequently been delisted. There are no breeding records for least Bell's vireo on Vandenberg AFB, and there are only two documented records of occurrence, both of which are east of the 13th Street Bridge. Both of these records are more than 10 years old (Holmgren and Collins 1999). Riparian point count surveys conducted over the past 10 years have not documented least Bell's vireo on Vandenberg AFB (Seavy et al. 2012); therefore, this species would not be affected by the Proposed Action.

Discovery of El Segundo blue butterfly [*Euphilotes battoides allyni* (ESBB)] on Vandenberg AFB did not occur until 2006 and Gaviota tarplant (*Deinandra increscens* ssp. *villosa*) was not listed as federally endangered until 2000; therefore these two species were not included in the above-mentioned consultations.

Section 7 consultation with USFWS also occurred for activities associated with the maintenance of the basewide network of firebreaks and fire access roads (USFWS 2006). This consultation encompassed the network of firebreaks and fire access roads in place around the exterior of SLC-4, and this BO has now been superseded by the Programmatic Biological (USFWS 2011b).

SpaceX is currently operating the Falcon Launch Vehicle Program at SLC-4E. Section 7 consultation with the USFWS was previously performed to support this launch program (USFWS 2011a). Previous consultations focused on modifying and using SLC-4E to support the Falcon 9 and Falcon 9 Heavy Programs. The operational check, abort test, and infrastructure improvements at SLC-4W, which is part of the current Proposed Action, were not included in previous section 7 consultations because these actions were not anticipated at the time the consultations were conducted.

A Falcon 9 launch from SLC-4E in September 2013 used 2 feet of water in the bottom of the flame duct for this launch in an effort to mitigate acoustical effects on the rocket. This water left the flame duct and impacted an adjacent drainage, Spring Canyon. These impacts had not been addressed within the applicable environmental planning documents (i.e., Environmental Assessment and Biological Opinion) (SRS Technologies, Inc. [SRS] 2005; USFWS 2006, ManTech SRS [MSRS] 2011, USFWS 2011a). SpaceX is currently performing activities to mitigate these impacts, such as invasive species treatment and seacliff buckwheat restoration (Tetra Tech 2014). To prevent future discharges into Spring Canyon, SpaceX has modified this procedure. The flame duct will no longer be pre-filled with water. All future launches from SLC-4E will be used with a dry flame duct, thus preventing water discharge to Spring Canyon.

2.0 Project Description

SpaceX's Proposed Action is to construct a 300-foot diameter concrete pad at Space Launch Complex 4 West (SLC-4W), two access roads and a FireX system and conduct an operational check of the boost-back and the first stage landing of the Falcon 9 vehicle, as well as perform an in-flight abort test of the Dragon capsule. The Proposed Action is needed to help meet requirements under the Commercial Crew Integrated Capability contract with the National Aeronautics and Space Administration. SpaceX is required to perform an in-flight abort test of the Dragon capsule at terminal velocity to ensure that the launch escape system performs as designed. Using SLC-4W for recovering the Falcon 9 first stage would allow SpaceX to provide

the necessary capability to efficiently conduct lower cost launch missions from Vandenberg AFB to support commercial and government clients.

The Air Force used SLC-4W as a launch site for the Titan program until it was decommissioned in 2005. SpaceX's model for reusability to promote cost effective access to space requires that the landing pad be close enough to the launch site to support timely processing of the recovered first stage for subsequent launches. The close proximity of SLC-4W to SLC-4E (the launch site) suits this model for reusability. SLC-4W is less than 0.25 mile from SLC-4E. SLC-4W is also an ideal landing site, because it is within the SLC-4 fence line and its access is controlled by SpaceX. It is less advantageous to manage security, communication, and utilities for a separate landing site outside of SLC-4 and more cost effective for the landing site to be within the immediate SLC-4 area. Figure 1 depicts SLC-4 and the overflight zone. Figure 2 presents the same information depicted in Figure 1 but at a larger scale.

Under the Proposed Action, SpaceX would undertake three related activities, which are described in detail below. Collectively, these activities would occur to support one mission and trajectory. The total time for the Dragon capsule in-flight abort test and Falcon 9 boost-back and landing will take approximately 4.6 minutes. The Proposed Action has the potential to occur any time throughout the year, but the currently planned timeframe would be between 1 September 2014 and 31 December 2015. The Proposed Action will occur once.

2.1 SLC-4W Improvements

As part of this Proposed Action, SpaceX would construct a 300-foot diameter concrete pad at the current SLC-4W site. There is currently no flat area within SLC-4W that can support this configuration without site grading activities. We anticipate that site grading would be required to provide a flat compacted area to construct the concrete pad. Up to 25,000 cubic yards of soil would be relocated and balanced (i.e., not requiring imported fill material). No soil would be transported off-site. Prior to landing activities, temporary scaffolding would be erected to the west of the landing pad at least a week before but would be removed after landing, as shown in Figures 3 and 4. The scaffolding would be covered with temporary panels for the purpose of radio frequency reflection (i.e., not reflective of sunlight) and would encompass an area of 250,000 square feet. Plywood will be placed over the top of the scaffolding and sand bags will be placed on footings to weigh down the scaffolding structure. Figure 3 shows the extent of scaffolding coverage. For the operational check and test, only the hatched area in Figure 3 would contain scaffolding. Flame associated with landing the first stage booster would not extend beyond the edges of the landing pad during landing.

Mowing would be performed regularly within the fenceline to decrease grass and shrub mass around the landing pad. This would reduce the likelihood of fire going off pad if an anomaly occurs. No artificial lighting will be installed at the landing pad.

Two new access roads, shown in Figure 3, would be developed as part of the Proposed Action. The area in the northeast corner would aid return of the first stage booster to the hangar currently located at SLC-4E. The second new access road would align partially with the current paved road. It would be a wider road capable of towing the first stage booster back to the hangar. The access roads would be graded and would be composed of compacted base material.

A FireX system would be constructed with 3 or 4 remote controlled water cannons (similar to SLC-4E) mounted on posts above ground to allow for remote firefighting capabilities. Existing underground water lines are sufficient in size to support the FireX system. A tie into the water system would be required and trenching for new water lines to connect to the FireX system is

required. Areas around the landing pad would be trenched to install piping. Trenching would be performed within already developed site areas and would not exceed 4 feet in depth and 1 foot in width. Areas where trenching would occur are shown in Figures 3 and 4. Trenching would follow standard trenching minimization measures on Vandenberg AFB.

Pacific Ocean
0
2
4
8 Miles
Legend
Helicopter Flight Path
Landing Overflight Path
Launch Overflight Path
Harbor
SLC-4 West
Maximum A-weighted SPL Contour (dBA)
70
80
90
100
110
Intermittent Surface Waterways
Perennial Surface Waterways
El Segundo Blue Butterfly (ESBB)
California Least Tern (CLTE) Nesting
Southern Sea Otter Rafting Areas
Marine Mammal Buffer Area
Western Snowy Plover (WSPL) Nesting Locations
California Red-legged Frog Occurrence
Marine Mammal Haul-Out Locations
Vandenberg AFB
Revised Draft Biological Assessment,
Boost-back and Landing of the Falcon 9R
and Dragon IFAT at Vandenberg AFB, SLC-4W
Listed Species Occurrence
in Project Area
TETRA TECH
5383 Hollister Ave, Suite 130
Santa Barbara, CA 93111
TC NO.
32320-04
DATE
06/19/2014
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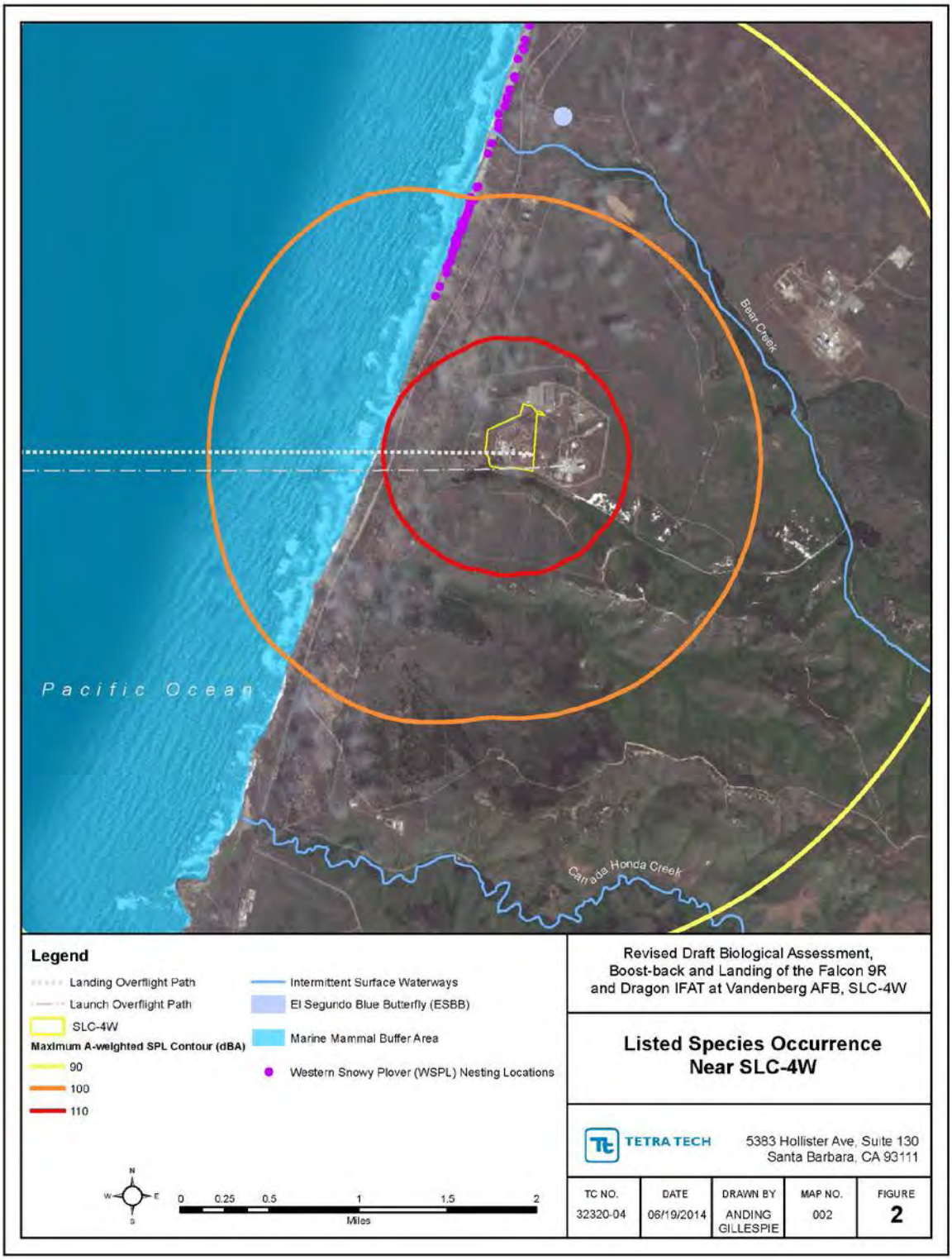
Pacific Ocean
Bear Creek
Canada Honda Creek
Legend
Landing Overflight Path
Launch Overflight Path
SLC-4W
Maximum A-weighted SPL Contour (dBA)
90
100
110
Intermittent Surface Waterways
El Segundo Blue Butterfly (ESBB)
Marine Mammal Buffer Area
Western Snowy Plover (WSPL) Nesting Locations
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Miles
Revised Draft Biological Assessment,
Boost-back and Landing of the Falcon 9R
and Dragon IFAT at Vandenberg AFB, SLC-4W
Listed Species Occurrence
Near SLC-4W
TETRA TECH
5383 Hollister Ave, Suite 130
Santa Barbara, CA 93111
TC NO. 32320-04
DATE 06/19/2014
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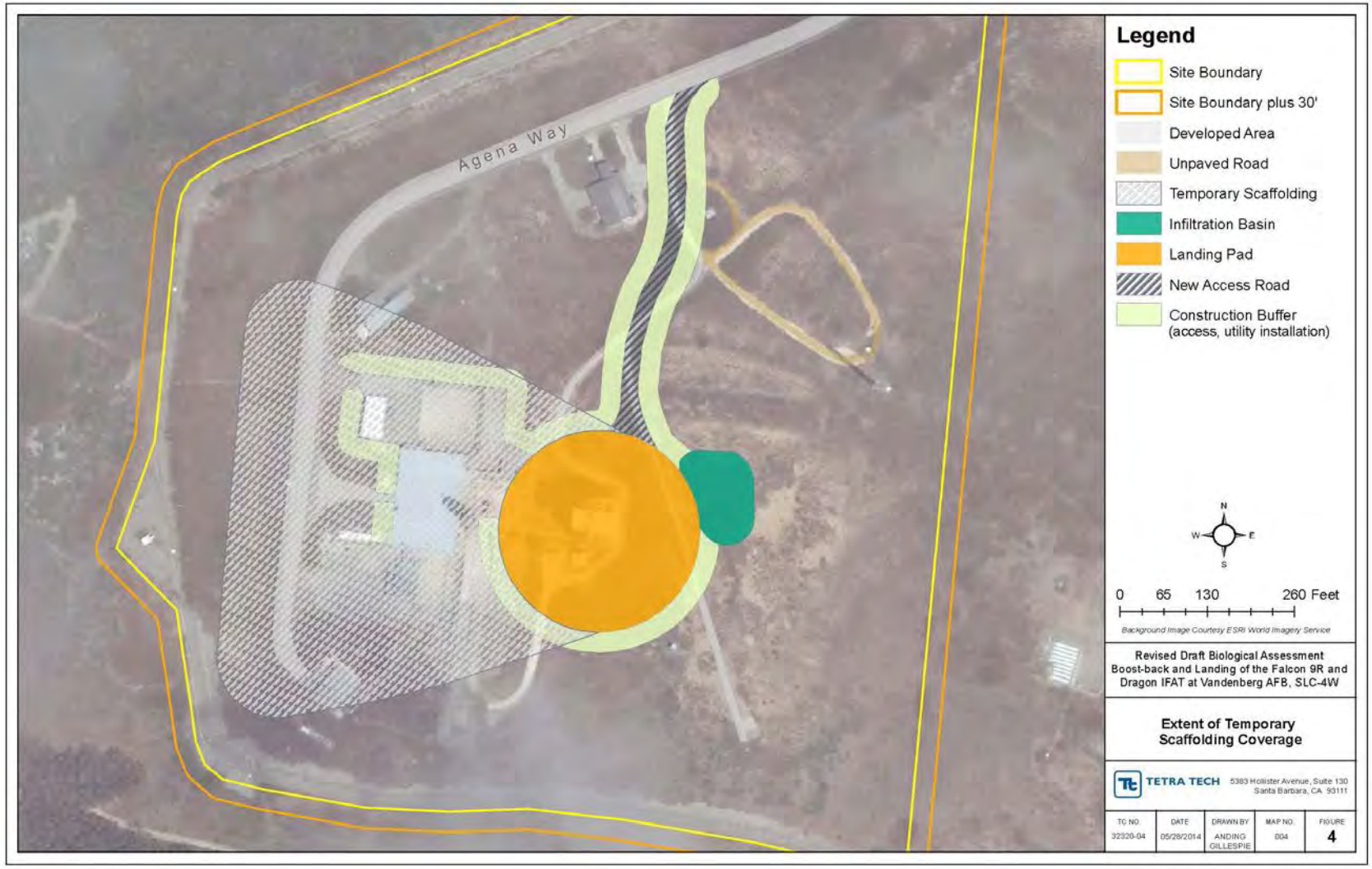
MAP NO. 002
FIGURE 2

Kelp Road
Surf Road
Agena Way
Legend
Site Boundary
Site Boundary plus 30'
Developed Area
Unpaved Road
Temporary Scaffolding
Infiltration Basin
Landing Pad
New Access Road
Seacliff Buckwheat
Non-native Grassland
Central Coast Scrub/
Non-native Grassland
N
W
E
S
0 100 200 400 Feet
Background Image Courtesy ESRI World Imagery Service
Revised Draft Biological Assessment
Boost-back and Landing of the Falcon 9R and
Dragon IFAT at Vandenberg AFB, SLC-4W
Biological Survey Results
TETRA TECH
5383 Hollister Avenue, Suite 130
Santa Barbara, CA 93111
TC NO. 32320-04
DATE 05/28/2014
DRAWN BY ANDING GILLESPIE
MAP NO. 003
FIGURE 3


Agena Way
Legend
Site Boundary
Site Boundary plus 30'
Developed Area
Unpaved Road
Temporary Scaffolding
Infiltration Basin
Landing Pad
New Access Road
Construction Buffer
(access, utility installation)
N
W
E
S
0 65 130 260 Feet
Background Image Courtesy ESRI World Imagery Service
Revised Draft Biological Assessment
Boost-back and Landing of the Falcon 9R and
Dragon IFAT at Vandenberg AFB, SLC-4W
Extent of Temporary
Scaffolding Coverage
TETRA TECH
5383 Hollister Avenue, Suite 130
Santa Barbara, CA 93111
TC NO.
32320-04
DATE
05/28/2014
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GILLESPIE
MAP NO.
004
FIGURE
4

The landing pad would be constructed to control all water runoff. A v-ditch surrounding the pad would be installed to provide containment for storm water and fire suppression. All storm water coming off the launch pad would be directed to an existing depression that would be directly adjacent to the landing pad. The earthen retention basin would be designed according to the California State Water Resources Control Board Construction General Permit. This infiltration area would be designed so that it will not permanently hold water and would infiltrate runoff from storm events or any fire suppression within 72 hours. This project feature is shown in Figures 3 and 4.

Construction is anticipated to take 90 to 120 days. During 30 days of this construction concrete would be curing and minimal construction activities and noise would occur.

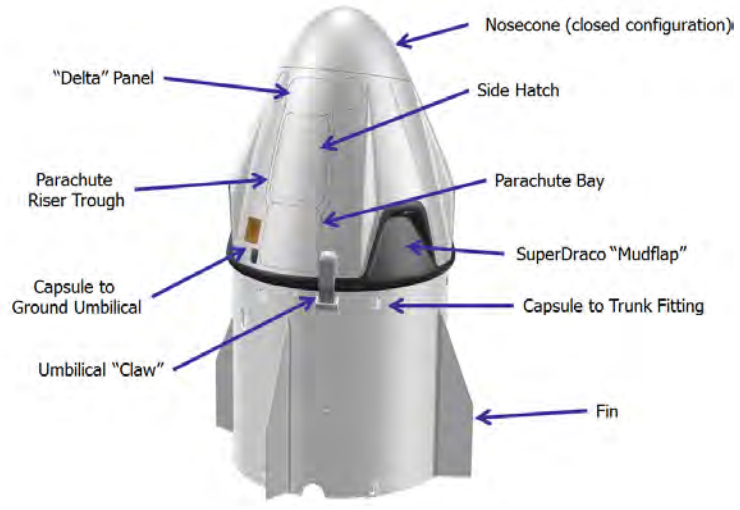
After the one-time test recovery of the Dragon capsule and first stage landing, the landing pad would be left in place for potential future use. Likewise, the two new access roads would be left in place for future use.

The entire SLC-4W complex and a 30-foot buffer around the complex is included in the project site for the purposes of this BA. A 30-foot buffer was included to survey the adjacent biological resources around SLC-4W.

Construction noise for the Proposed Action would remain under 90 A-weighted decibel scale (dBA), in compliance with OSHA regulations. Impacts to listed species are considered for all areas potentially impacted by construction noise.

2.2 In-Flight Abort Test

The Dragon capsule is a specialized payload (carried by the Falcon vehicle) that comprises a pressurized capsule and unpressurized trunk, thereby capable of carrying pressurized and unpressurized cargo, as well as humans. The Dragon capsule is 3.6 meters in diameter and 2.8 meters high and is shown in Graphic 1.



Graphic 1: Dragon Abort Test Vehicle

After launch, approximately 60 seconds into flight at Mach 1, the Dragon and its trunk would be released from the interstage and the SuperDraco thrusters would initiate the launch escape system. After separation from the interstage, the Dragon would initiate a course directly west (toward the ocean) from the launch vehicle. The SuperDraco thrusters would burn to completion at a constant rate of thrust to ensure the Dragon reaches a safe distance away from the Falcon 9 first stage and to achieve a suitable water landing. Dragon splashdown is anticipated 2.5 kilometers (km) (1.5 miles) offshore, and trunk landing is anticipated to be, at minimum, equal to the distance from shore as the Dragon capsule (1.5 miles) or maximum up to twice the distance (3.0 miles). The anticipated splashdown speed of the Dragon capsule is 7.2 meters/second (16 miles per hour). Mission parameters would require that all propellant be used up during the escape procedure. We anticipate that only residual propellant would be inside the fuel tanks when the Dragon makes its water landing. The Dragon's trunk contains no active electrical or pressure systems and will only contain dummy weight for ballast to replicate nominal operational weights.

Recovering the Dragon after splashdown would be similar to recovery operations after return to earth from International Space Station missions. Using a commercial provider, SpaceX would have a vessel or helicopter that is capable of executing fast, safe recovery operations and collecting high-rate telemetry from the test article. This would be similar to previous SpaceX operations collecting telemetry at sea and recovering cargo Dragon capsules (SpaceX 2014).

This one-time test recovery of the Dragon would be planned as a daylight operation off the coast of Vandenberg AFB. The in-flight abort test would be used to assess the system for future but unanticipated actions. There would be two primary recovery methods.

The preferred method would use a helicopter and small support vessel to rig the Dragon capsule and lift it out of the water. A Sikorsky S-64E Skycrane helicopter configured with long line would originate from either the Santa Maria Airport or the Vandenberg AFB flightline. To minimize noise disturbance the helicopter would remain at an altitude over 1,000 feet unless actively retrieving (offshore) or cradling (at the Vandenberg Harbor) the Dragon. The top speed of the helicopter would be 126 miles per hour. The path the helicopter would take is shown in Figure 1. Helicopter flight path before and after Dragon recovery would be determined by the Vandenberg AFB flightline supervisor and would follow currently used flight paths for normal air traffic over the base.

The second method is to tow the Dragon capsule back to port either using a raft or by towing the capsule directly through the water. The 100-foot ship would originate from Long Beach Harbor and position in the water just south of the Dragon capsule splashdown area, as close as the Range will allow. The time of arrival at the Dragon capsule depends on the time of the launch. Offshore, the ship would maintain a speed of 8 nautical miles per hour. A smaller boat, such as a 21-foot ASIS center console boat or 18-foot Nautica wide body, would accompany the 100-foot ship and assist in inspecting the Dragon capsule after splashdown. Within 1,000 feet of the harbor, ship speeds would be reduced to approximately 2 to 3 knots. All vessel speed would be monitored using Global Positioning System (GPS).

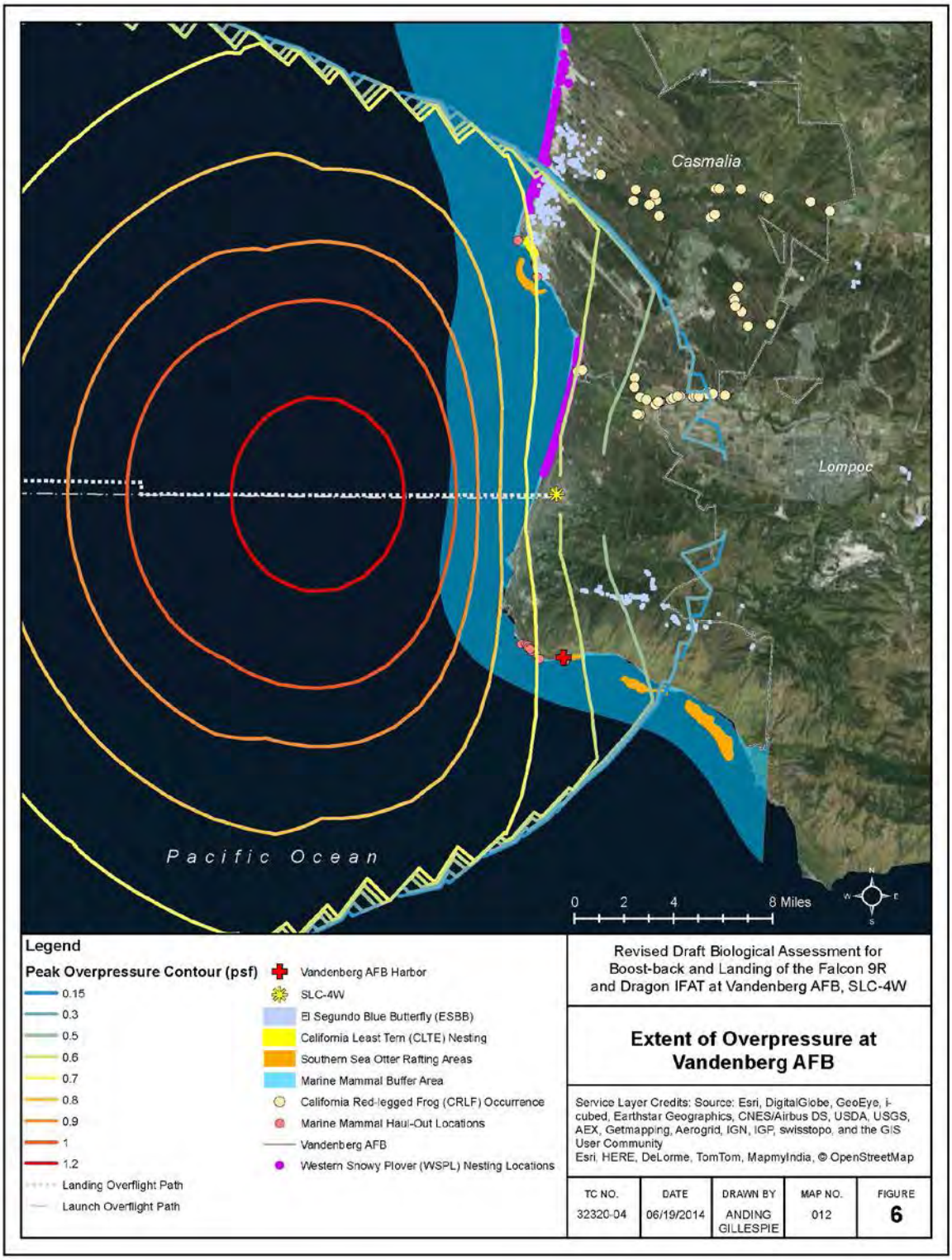
Regardless of recovery method, SpaceX intends to use the south Vandenberg boat dock to bring the Dragon back to land. Harbor actions are covered for pinniped effects by a Letter of Authorization with the National Marine Fisheries Service (National Marine Fisheries Service 2014). Prior to bringing the Dragon into the Vandenberg AFB harbor, the harbor area would be cleared of all non-essential personnel. After the Dragon is secured at the Vandenberg AFB harbor, prior to approaching or moving the Dragon, any propellant vapors immediately surrounding the Dragon would be monitored using vapor detectors for monomethyl hydrazine and dinitrogen tetroxide, and vapors would be allowed to fall below permissible exposure limits

(PEL). Once deemed safe for transfer, the Dragon would be transferred to a truck trailer using a crane. The truck would then transport the Dragon to a processing location within the harbor area for hypergolic fuel offloading activities. Any fuel offload and final transport measures would be performed over secondary containment.

2.3 Boost-back and Landing

Under the Proposed Action the Falcon 9 first stage would return to Vandenberg AFB for potential reuse. The Falcon 9 first stage is 12 feet in diameter and 160 feet in height, including the interstage which will be attached during landing. After the first stage engine cutoff, exoatmospheric cold gas thrusters would be triggered to flip the first stage into position for retrograde burn. Three of the nine first stage Merlin engines would be restarted to conduct the retrograde burn to reduce the velocity of the first stage and to place the first stage in the correct angle to land. Once the first stage is in position and approaching its landing target, the three engines would be cut off to end the boost-back burn. The landing legs on the first stage would then deploy in preparation for a final single engine burn that would slow the first stage to a velocity of zero before landing on the landing pad at SLC-4W. Landing noise measurements for the Proposed Action are shown in Figure 1. In addition, the landing of the first stage is anticipated to generate a sonic boom. Sonic booms are categorized as high energy impulsive sound. The peak overpressure contours associated with the sonic boom are shown on Figures 5 and 6. Impacts to listed species are considered for all areas potentially impacted by visual disturbance, landing noise, and sonic boom.

Pacific Ocean
SAN LUIS OBISPO
SANTA BARBARA
Cambria
Templeton
Atascadero
Morro Bay
Baywood Park
San Luis Obispo
Pismo Beach
Grover Beach
Nipomo
Santa Maria
Lompoc
Buellton
Santa Ynez
Solvang
Goleta
Santa Barbara
Carpinteria
Taft
Legend
Peak Overpressure Contour (psf)
0.15
0.3
0.5
0.6
0.7
0.8
0.9
1
1.2
2.4
SLC-4W
Landing Overflight Path
Launch Overflight Path
Vandenberg AFB
N
W
E
S
0 5 10 20 30 40
Miles
Revised Draft Biological Assessment,
Boost-back and Landing of the Falcon 9R
and Dragon IFAT at Vandenberg AFB, SLC-4W
Extent of Overpressure
TETRA TECH
5383 Hollister Ave, Suite 130
Santa Barbara, CA 93111
TC NO.
32320-04
DATE
05/28/2014
DRAWN BY
ANDING GILLESPIE
MAP NO.
005
FIGURE
5


Casmalia
Lompoc
Pacific Ocean
0 2 4 8 Miles
N
W
E
S
Legend
Peak Overpressure Contour (psf)
0.15
0.3
0.5
0.6
0.7
0.8
0.9
1
1.2
Landing Overflight Path
Launch Overflight Path
Vandenberg AFB Harbor
SLC-4W
El Segundo Blue Butterfly (ESBB)
California Least Tern (CLTE) Nesting
Southern Sea Otter Rafting Areas
Marine Mammal Buffer Area
California Red-legged Frog (CRLF) Occurrence
Marine Mammal Haul-Out Locations
Vandenberg AFB
Western Snowy Plover (WSPL) Nesting Locations
Revised Draft Biological Assessment for Boost-back and Landing of the Falcon 9R and Dragon IFAT at Vandenberg AFB, SLC-4W
Extent of Overpressure at Vandenberg AFB
Service Layer Credits: Source: Esri, DigitalGlobe, GeoEye, i-cubed, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AEX, Getmapping, Aerogrid, IGN, IGP, swisstopo, and the GIS User Community
Esri, HERE, DeLorme, TomTom, MapmyIndia, © OpenStreetMap
TC NO. 32320-04
DATE 06/19/2014
DRAWN BY ANDING GILLESPIE
MAP NO. 012
FIGURE 6

2.4 Summary of Key Project Elements

The following are key aspects of the Proposed Action that are related to federally listed species:

- The boost-back and abort test will be conducted during the daytime and will occur once.
- No artificial lighting will be installed at the landing pad.
- Temporary scaffolding will be covered with temporary panels for the purpose of radio frequency reflection (i.e., not reflective of sunlight).
- Ground disturbance will occur within the footprints of the landing pad, infiltration area, and new access roads shown in Figures 3 and 4. Scaffolding will be temporary and in the location shown in Figures 3 and 4. Areas around the landing pad would be trenched to install piping. Areas where trenching would occur are also shown in Figures 3 and 4.
- Landing impacts (except noise and visual impacts) will not extend beyond the landing pad footprint shown in Figures 3 and 4.
- The infiltration basin would not permanently hold water and would infiltrate runoff from storm events and any fire suppression within 72 hours.
- Landing of the first stage at SLC-4W will rely on a single engine burn, as compared to nine engines that were used for the previous Falcon 9 launch. As a result, landing noise will be less than that generated by the previous Falcon 9 launch from SLC-4E. Noise associated with the landing of the first stage is shown in Figure 1.

2.5 Minimization and Monitoring Measures

The minimization and monitoring measures listed below for ESBB, California least tern [*Sterna antillarum browni* (CLTE)], WSPL, CRLF, and southern sea otter would be implemented to minimize and/or characterize the effects of planned project activities.

2.5.1 El Segundo Blue Butterfly

- Areas with seacliff buckwheat (*Eriogonum parvifolium*) would be flagged and a 2-foot buffer maintained where avoidance does not jeopardize fire suppression, security requirements, or program operation needs.
- If removing or damaging seacliff buckwheat is necessary to meet fire suppression, security requirements, or program operation needs, a biological monitor would be present to ensure impacts are minimized and quantified.
- Vegetation clearance and access road construction would occur outside of the ESBB flight season, 1 June through 15 September, if feasible.
- ESBB habitat would be enhanced at a 2:1 ratio (habitat enhanced: habitat affected). Enhancement activities would include herbicide treatment and hand removal of invasive species, planting native seedlings, and sowing native seed. Herbicides would not be applied during the flight season (1 June through 15 September). USFWS-approved biologists would collect native seed for sowing and propagating buckwheat seedlings.
- Only buckwheat species that are native to Vandenberg AFB will be planted.

2.5.2 California Least Tern

- The boost-back and abort test would occur outside of the CLTE breeding season, 15 April through 15 August, if feasible.
- Monitoring of nesting CLTE at Purisima Point and foraging CLTE at the Santa Ynez River estuary would be conducted to determine impacts from the boost-back and landing at SLC-4W when CLTE are present.
    - A USFWS-approved biologist would conduct population censuses up to 3 days before the boost back and landing to establish use patterns, monitor behavior during the boost-back and landing using video monitoring, and conduct population censuses and note any mortality, injury or abnormal behavior for up to 3 days following the landing to compare with pre-landing numbers.

2.5.3 Western Snowy Plover

- The boost-back and abort test would occur outside of the WSPL breeding season, 1 March through 30 September, if feasible.
- Monitoring of nesting WSPL at south Surf Beach would be conducted to determine impacts from the landing at SLC-4W and reproductive success between 1 March and 30 September.
    - A USFWS-approved biologist would conduct population censuses up to 3 days before the boost-back and landing to establish use patterns, monitor behavior during the boost-back and landing using video monitoring, and conduct population censuses and note any mortality, injury or abnormal behavior for up to 3 days following to compare with pre-landing numbers.

2.5.4 California Red-legged Frog

- If construction activities are conducted during the wet season and water is present in Spring Canyon, daily pre-construction surveys would be conducted to ensure that dispersing frogs have not entered the project site.
- If trenching activities occur during the wet season, open trenches would be inspected at the end of the day for the presence of CRLF, covered at night, and inspected in the morning to determine whether CRLF have inadvertently become trapped in the trenches.
- A USFWS-approved biologist would relocate all life stages of CRLF found within the project site to the nearest suitable habitat outside of the project site but within the same watershed.
- Silt fence will be installed in between the project site and Spring Creek to ensure no siltation occurs and to minimize dispersing frogs from entering the project site.

2.5.5 Southern Sea Otter

- A biologist would monitor the ship arrival and departure at the Vandenberg Harbor.
- The biologist would survey the Harbor area prior to ship arrival or departure to locate any Southern sea otters that are present. Instructions increasing likelihood of avoidance would be disseminated.
- Within the Harbor and within one-quarter mile of the Harbor, the ship will maintain a speed of less than ten nautical miles per hour near any rafting otters.

- After transporting the Dragon to a processing location within the harbor area, fuel offload and final transport measures would be performed over secondary containment to prevent contamination within the Harbor.

3.0 Status of the Species

Seacliff buckwheat, the host plant for the federally endangered ESBB, occurs within the SLC-4W complex. The federally listed CRLF, CLTE, WSPL, and southern sea otter occur outside of the SLC-4W complex, but may be affected by the Proposed Action (Figure 1).

3.1 El Segundo blue butterfly [Federal Endangered Species]

The ESBB is a member of the Family Lycaenidae. Males of this species have blue on the dorsal surface of their wings, while females have brown on the dorsal surface of their wings. Both sexes have boldly spotted lower wings, checkered wing margins and a bold orange aurora. The butterflies range in size from 1.7 to 2.1 centimeters (Opler 1999). The species was listed as federally endangered on June 1, 1976 (40 Federal Register [FR] 48139 - 48140).

Critical habitat was proposed for ESBB in 1977, but has yet to be designated. As a result, the Proposed Action is not in critical habitat. ESBB were formerly thought to be restricted to the El Segundo dunes in Los Angeles County. However, invertebrate surveys conducted on Vandenberg AFB in 2004 and 2005 documented butterflies morphologically, temporally and behaviorally consistent with ESBB (Pratt 2006). These butterflies were subsequently determined by the USFWS to be ESBB based on these criteria.

The taxonomy of the genus *Euphilotes* is complex, with species converging on the same hosts, and occurring in similar climatic conditions often exhibiting convergent morphology to the degree that they appear superficially to be more similar to one another than to more closely related species and subspecies occupying different niches (Mattoni 1992, Pratt 2006). Coastal populations of *E. bernardino,* another member of the *E. battoides* complex, and *E. battoides* have demonstrated convergence of phenotypes when occupying similar habitats (Mattoni 1992) as have populations of *E. enoptes* (Pratt 2006). Pratt recommended molecular studies to clarify the taxonomic status of Vandenberg AFB butterflies (Pratt 2006); preliminary studies concluded in 2008 were largely inconclusive.

ESBB is found in coastal dune scrub, along coastal bluffs, and in central coastal scrub. Vandenberg AFB ESBB adults may be on wing from mid-June through August and are closely associated with their host plant, seacliff buckwheat. Eggs are deposited on buckwheat flowerheads where the larvae feed until maturation. Upon maturation, larvae burrow into the soil and pupate below the host plant. Most pupation occurs within the root and debris zone of the host plant (Mattoni 1992). Pupae remain in diapause until the following June. The number that eclose on a given year is dependent on environmental conditions with the majority of the population remaining in diapause on any given year (U.S. Air Force 2012).

To date, ESBB has been documented at the locations on Vandenberg AFB that are shown in Figure 1. The species was generally found in coastal back dune habitats and central coast scrub. Vandenberg AFB surveyors have also located ESBB in several locations off Vandenberg AFB in 2009, 2010, 2011, 2012, and 2013, as shown in Figure 1. Continued surveys will be conducted in future years to assess extent of populations and identify habitat characteristics that most favor this species.

3.2 California Red-legged Frog [Federal Threatened Species]

The CRLF is the largest native frog in the western United States. It once ranged across much of California, including portions of the Sierra Nevada Mountain Range. The present distribution ranges from Sonoma and Butte Counties in the north to Riverside County in the south, where they occur primarily in wetlands and streams in coastal drainages of central California. This species was listed as federally threatened on May 23, 1996 (61 FR 25813).

The USFWS designated critical habitat for CRLF on March 13, 2001 (66 FR 14626). Several revisions to the critical habitat have occurred and been proposed. However, Vandenberg AFB was excluded from this designation under section 4(b)(2) of the ESA. As a result, the proposed project is not in critical habitat.

CRLF are known to occur from sea level to 1,500 meters elevation and occupy a variety of aquatic habitats, including natural and artificial ponds and reservoirs, streams and other watercourses, freshwater lagoons, springs, and seeps (Bulger et al. 2003). CRLF occur in different habitats depending on their life stage, the season, and weather conditions. All life history stages are most likely to be encountered in and around breeding sites, which are known to include coastal lagoons, marshes, springs, permanent and semi-permanent natural ponds, ponded and backwater portions of streams, as well as artificial impoundments such as stock ponds, irrigation ponds, and siltation ponds. Dense, shrubby, or emergent vegetation closely associated with deep-water pools with fringes of cattails and dense stands of overhanging vegetation, such as willows, are considered optimal breeding habitat. CRLF breed from November to April, usually laying egg masses during or shortly following large rainfall events from late December to late April.

CRLF require aquatic habitat for breeding and cover but also use a variety of other habitat types, including riparian and upland areas during periods of wet weather, starting with the first rains of fall. Yearly rainfall patterns may affect the breeding season duration in perennial streams on Vandenberg AFB due to the availability of deep water pools. Areas not suitable for breeding may function as foraging habitat or refugia for dispersing frogs. CRLF often disperse from their breeding habitat as water levels fall below approximately one meter, finding cover in upland areas under brush or duff to retain moisture. Adult frogs that have access to permanent water will generally remain active throughout the year. CRLF are known to disperse as far as 1.8 miles from breeding habitat and proximity to another suitable site cannot be used to predict directional dispersal probabilities (Bulger et al. 2003).

3.3 California Least Tern [Federal Endangered Species]

The CLTE is the smallest North American tern and is found along the Pacific Coast, from San Francisco to Baja California. It has a distinctive black cap with stripes running across the eyes to the beak. It has gray upperparts and white on its breast and belly. The USFWS listed the CLTE as federally endangered on October 13, 1970 (35 FR 16047-16048).

Coastal development has resulted in CLTE habitat loss. This, in turn, has resulted in localized and increasingly fragmented populations of the species. CLTE are migratory and winter along the Pacific coast of southern Mexico and the Gulf of California. They usually arrive at breeding grounds by the last week of April and return to wintering grounds in August. CLTE nests in colonies on relatively open beaches kept free of vegetation by natural scouring from tidal action.

Historically, CLTE nested in colonies in several locations along the coastal strand of the north Vandenberg AFB coastline. The current primary colony site for CLTE is at Purisima Point. This site is on a relatively undisturbed bluff-top in open dune habitat.

CLTE forage in the lagoons formed at the mouths of the Santa Ynez River and San Antonio Creek, and at other near-shore locations at Vandenberg AFB. Vandenberg AFB supports a very small percentage of California's breeding population of CLTE. However, as one of only three known breeding colonies between Monterey and Point Conception, the population on Vandenberg AFB remains significant.

Critical habitat for this species has not been designated. As a result, the Proposed Action would not affect critical habitat for the CLTE.

3.4 Western Snowy Plover [Federal Threatened Species]

The WSPL is a small shorebird with a pale tan back, white underparts, and dark patches behind the eyes and on the sides of the neck reaching around to the top of the chest. The USFWS listed the Pacific coast population of the WSPL as federally threatened in March of 1993 (58 FR 12864-12874). This population is limited to individuals that nest adjacent to tidal waters. The population's range extends from southern Washington to Baja California, Mexico.

Vandenberg AFB provides important breeding and wintering habitat for WSPL. WSPL habitat on Vandenberg AFB includes all sandy beaches and adjacent coastal dunes from the rocky headlands at the north end of Minuteman Beach to the pocket beaches and dune areas adjacent to Purisima Point on north Vandenberg AFB (approximately 7.7 miles). Sandy beaches and adjacent coastal dunes from the rocky headlands at the north end of Wall Beach south to the rock cliffs at the south end of Surf Beach on south Vandenberg AFB (approximately 4.8 miles) are also included in WSPL habitat. Vandenberg AFB has consistently supported one of the largest populations of breeding WSPL along the west coast of the United States (Page and Persons 1995). In 2009, Vandenberg AFB supported an estimated 11 percent of California's breeding population (USFWS 2009); however, this estimate was as high as 22 percent in 2004.

The USFWS designated critical habitat for this species in 1999 and revised this designation on 29 September 2005 (70 FR 56969-57119). Vandenberg AFB was exempted from critical habitat designation under section 4(a)(1) of the ESA.

3.5 Southern Sea Otter [Federal Threatened Species]

The southern sea otter is the smallest species of marine mammal in North America, occurring in near shore marine environments of California from San Mateo County to Santa Barbara County. The USFWS listed the sea otter as federally threatened on January 14, 1977 (42 FR 2965).

The southern sea otter breeds and gives birth year-round. Pups are dependent for 120 to 280 days (average 166 days; Riedman and Estes 1990). Sea otters are opportunistic foragers known to eat mostly abalones, sea urchins, crabs, and clams. Sea otters play a key ecological role in kelp bed communities by controlling sea urchin populations, which graze on the kelp.

Sea otters inhabit the near shore waters along Vandenberg AFB. Surveys conducted in 2006, as a monitoring requirement for a Delta IV launch, documented the presence of up to 55 adults in the near shore waters off of the Sudden Flats area of south Vandenberg AFB (SRS 2006a). Sea otters are frequently seen at the Vandenberg Harbor. However, these observations are generally short in duration, and no known breeding has occurred at this location (R. Evans, personal communication, 30 April 2014).

Critical habitat for this species has not been designated. As a result, the proposed project would not affect critical habitat for the sea otter.

4.0 Survey Methods

Prior to the field survey, a review of the Vandenberg AFB Geographic Information System (GIS) data was conducted to assess potential occurrences of special-status species at SLC-4W and the 30-foot buffer, surrounding area, and overflight zone (Figure 1).

A seacliff buckwheat survey and CRLF habitat assessment was conducted by Tetra Tech at SLC-4W on March 11, 2014. The survey area included the entire SLC-4W complex as well as a 30-foot buffer from the outer perimeter fence. Meandering transects were conducted over the entire site. Two biologists walked the survey area and visually surveyed for CRLF habitat and seacliff buckwheat.

An additional seacliff buckwheat survey and CRLF habitat assessment was conducted on April 9, 2014. This survey focused on the new access road proposed in the northeast corner and a 30-foot buffer around this area.

CRLF have potential to occur in virtually all Vandenberg AFB wetlands, including streams and other watercourses, such as drainages (Christopher 1996, 2004a, 2004b, Bulger et al. 2003). Therefore, the CRLF habitat assessment focused on finding defined channels, wetland vegetation, standing water, or areas that would hold water during wet periods.

Seacliff buckwheat stands were mapped using a Trimble Geo XT GPS unit. Vegetation communities were mapped by hand using aerial photographs.

5.0 Survey Results

5.1 Vegetation Types

Two vegetation types were identified in the project site: non-native grassland and central coast scrub/non-native grassland. Areas covered by pavement or other manmade structures were mapped as developed (9.1 acres). Table 1 provides acreages of each vegetation type within the project site. Figure 3 depicts the vegetation types within the project site. Nomenclature follows Holland (1986), when applicable. Vegetation types are described in detail below.

Table 1. Acreage of vegetation types found within the project site and 30-foot buffer.

Vegetation Type	Acreage
Non-native Grassland	25.1
Central Coast Scrub/Non-native Grassland	2.4

Non-native Grassland consists of annual and non-native forbs and grasses. Iceplant (*Carpobrotus edulis*) and veldt grass (*Ehrharta calycina*) were the dominant species observed within these communities. A few native species were sparsely observed within non-native grasslands. These species included California-aster (*Corethrogyne filaginifolia*), deerweed (*Acmispon glaber*), and miniature lupine (*Lupinus bicolor)*. Seacliff buckwheat populations were also observed within the non-native grassland communities.

Central Coast Scrub is characterized by shallow-rooted, mesophyllic plant species that are often drought-deciduous and summer-dormant. Past disturbances have facilitated establishing many non-native species, such as iceplant, within this vegetation type. The dominant native species in this habitat are California sagebrush (*Artemisia californica*) and coyote brush (*Baccharis pilularis*).

5.2 El Segundo Blue Butterfly

One hundred and eighteen (118) seacliff buckwheat plants were documented during surveys conducted in March 2014 within the project site, as shown in Figure 3. Seacliff buckwheat occurs sparsely throughout SLC-4W in areas dominated by non-native grasses and iceplant. The presence of seacliff buckwheat within and adjacent to the project site indicates the potential for ESBB to also occur within the project site. The SLC-4W project site is approximately 1.2 miles from the nearest known location of the ESBB. This locality represents an isolated individual observed at Bear Creek and Coast Roads in 2008. Subsequent surveys in the area conducted in 2008, 2009, 2011, 2012, and 2013 failed to document additional ESBB (MSRS 2010b, 2013). ESBB have also never been documented in the overflight zone. The closest and most recently documented ESBB population occurs on Honda Ridge approximately 3.2 miles south-southeast of the project site (R. Evans, personal communication, 30 April 2014).

5.3 California Red-legged Frog

The nearest suitable CRLF breeding habitat is located approximately 200 feet south of the SLC-4W southern boundary in Spring Canyon. Spring Canyon is an ephemeral drainage located immediately south of SLC-4 and has not contained water for the last 2 years due to low rainfall amounts and drought conditions (J. Hauenstein, personal communication, 30 May 2014). Protocol-level surveys have not been conducted for CRLF within Spring Canyon; however, this species has potential to occur in various aquatic habitats, including natural and artificial ponds and reservoirs, streams and other watercourses, freshwater lagoons, springs, and seeps (Bulger et al. 2003).

Between October and December 2013, a full CRLF habitat assessment was conducted in Spring Canyon, approximately 200 feet south of SLC-4W (MSRS 2013). MSRS determined that intermittent potential CRLF habitat occurs in Spring Canyon (MSRS 2013).

During the habitat assessment conducted by Tetra Tech in March 2014, defined channels, standing water, streams, or wetland vegetation were not observed within SLC-4W. A cement basin occurs within the developed area of the site; however, no standing water or wetland vegetation was observed. Water was not observed in Spring Canyon during the assessment; however, access in the canyon was restricted during the assessment due to in-progress explosives operations. SLC-4W does not contain potential CRLF breeding habitat.

The project site is 1.53 miles south of the nearest documented CRLF location and breeding habitat in the Bear Creek lagoon (SRS 2001a). CRLF have also been documented in Honda Creek to the south (MSRS 2013). Bear Creek and Honda Creek are not within the project site or overflight zone. No CRLF have been documented within the overflight zone. However, as previously stated, potential CRLF habitat does occur adjacent to SLC-4 in Spring Creek (MSRS 2013). Spring Canyon would be impacted by boost-back vehicle landing noise of 110 dBA, as shown in Figure 1. Bear Creek and Honda Creek would be impacted by vehicle boost-back and landing noise of 90 dBA. As shown in Figure 6, Spring Canyon would experience a sonic boom of approximately 0.6 psf. Honda Canyon would experience a sonic boom of approximately 0.6 to 0.7 psf, and Bear Creek would experience a sonic boom of 0.6 psf or less.

5.4 California Least Tern

CLTE foraging and breeding areas are not within the overflight zone of the Proposed Action. The nearest CLTE nesting site to SLC-4W is located at Purisima Point, approximately 8 miles north. Breeding pairs, ranging from one to 82 pairs since 1995, are present from late April to early September (Robinette and Ball 2013). After young have fledged, CLTE typically disperse to the Santa Ynez River lagoon (Robinette and Howar 2010), approximately 3.7 miles north of SLC-4W, where they forage and roost on sandbars. Foraging at the Santa Ynez River lagoon can occur throughout the breeding season, but occurrence is typically irregular with the exception of the period when birds are initially dispersing from Purisima Point. Both Purisima Point and the Santa Ynez River mouth are outside of the area that could be impacted by visual disturbance, boat and ship operations, and helicopter overflights. However, CLTE within these areas could be affected by landing noise disturbance and sonic boom of approximately 0.6 psf, as shown in Figure 6.

5.5 Western Snowy Plover

WSPL nest and overwinter along the coast of VAFB. From 1991 to 2006, VAFB consistently supported over 10 percent of the California breeding population of WSPL (USFWS 2007). In 2004, VAFB supported a high of 420 WSPL and an estimated 22 percent of California's population of the species (USFWS 2007). The nearest observation of a WSPL nest is approximately 0.5 mile northwest of the project site and 0.87 mile from the overflight zone (Figure 1). However, a portion of the most southern WSPL nesting habitat falls within areas that may be impacted by boost-back landing noise and visual disturbance, as shown in Figure 1. All WSPL nesting habitat on Vandenberg AFB is expected to be impacted by a sonic boom of approximately 0.7 psf or less, as shown in Figure 6.

5.6 Southern Sea Otter

Southern sea otters occur regularly off the coast of Vandenberg AFB, with animals typically concentrated in the kelp beds offshore of Purisima Point on North Vandenberg AFB, and offshore of Sudden Flats on south Vandenberg AFB. Sea otters could be impacted by visual disturbance, noise, sonic boom, boat and ship operations, and helicopter overflights. Estimating the number of sea otters that may be affected by project activities is difficult, given that numbers of this species present at any given time cannot be accurately predicted.

6.0 Other Species Considered

Beach Layia

There will be no effect on beach layia as a result of the Proposed Action. There is no suitable beach layia habitat within the project site. Suitable habitat for beach layia consists of semi-stabilized sand in sparse coastal dune scrub vegetation. The project site consists of non-native grassland and central coast scrub/non-native grassland habitats, developed infrastructure, paved roads, and compacted dirt roads. The closest known beach layia location is located 1,380 feet northwest of SLC-4W off of Kelp Road.

ManTech SRS performed beach layia surveys in 2010 that documented 2,996 individual beach layia plants on South Vandenberg AFB (MSRS 2010d). Beach layia was discovered growing on San Antonio Terrace on north Vandenberg AFB in 2011, and subsequent surveys in 2012 documented 2,397 individuals within 28 separate stands on north Vandenberg AFB (SAIC

2012). Beach layia is an annual species that lives in a dynamic habitat. Therefore, abundance and distribution of this species is expected to fluctuate year to year depending on environmental factors (USFWS 1998).

No deposition of harmful chemicals should take place as a result of landing activities. Landing would occur on the concrete pad that will have perimeter control for storm water; therefore, even in the event of an anomaly, all fuel used on the rocket should be contained. Solid rocket motors (SRMs) would not be used. The propellants to be used are liquid; therefore, there will be no acid deposition.

Gaviota Tarplant

There will be no effect on Gaviota tarplant as a result of the Proposed Action. Gaviota tarplant is known in the Sudden Peak area (Baldwin 2009), which is outside the project area. During surveys conducted on SLC-4E in 2008, plants were predominantly consistent with the *Deinandra increscens* ssp. *increscens* phenotype (MSRS 2009a). Dead material present during 2010 field surveys was also consistent with *D. increscens* ssp. *increscens*, and new growth from 2010 was still in early vegetative condition (MSRS 2010a). During the March 2014 survey conducted by Tetra Tech, only dried out, dead tarplant material was present.

Tidewater Goby

There will be no effect on tidewater goby as a result of the Proposed Action. The nearest tidewater goby potential habitat is in Cañada Honda Creek, approximately 2.6 miles southwest of the project site. When they occurred, the gobies were confined to the lagoon within Cañada Honda Creek (Swift et al. 1997). Gobies were not present at this site in 2008 (MSRS 2009b). During 2010 field surveys, the lagoon was open to the ocean, making recolonization of the site possible. The nearest and most currently known occupied habitat is the Santa Ynez River, 3.5 miles north of the project site.

No toxic chemical deposition should occur as a result of the Proposed Action. Landing would occur on the concrete pad that will have perimeter control for storm water; therefore, even in the event of an anomaly, all fuel used on the rocket should be contained. SRMs would not be used. The propellants to be used are liquid; therefore, there will be no acid deposition. Cañada Honda Creek was successfully colonized by the species under the previous Titan launch program at SLC-4 (MSRS 2010a). All occupied tidewater goby habitat is outside of the project area and overflight zone.

Unarmored Threespine Stickleback

There will be no effect on unarmored threespine stickleback (UTS) as a result of the Proposed Action, since the species is no longer present within the overflight zone. A joint effort between the USFWS and Vandenberg AFB introduced UTS from the Barka Slough section of San Antonio Creek into the middle and upper sections of Cañada Honda Creek in 1984. The population survived the initial introduction and was able to reproduce (MSRS 2010a). However, by August of 1987 few fish were found in the creek, and intensive surveys conducted by MSRS in 2008 failed to find UTS in Cañada Honda Creek (MSRS 2009b). This indicated that the re-introduction was unsuccessful and the Cañada Honda population was extirpated.

Southwestern Willow Flycatcher

There will be no effect on southwestern willow flycatcher (SWFL) as a result of the Proposed Action. From 1995 to 2004, a small population of up to five adult SWFL occurred on Vandenberg AFB. This population occurred at two sites. One site occurred in willow riparian habitat on the north bank of the Santa Ynez River, west of 13th Street. The second site occurred at the waterfowl natural resources area also on the north bank of the Santa Ynez

River. The lower Santa Ynez River was heavily scoured by abnormally high rainfall and water flow in 2001, which naturally removed much of the suitable SWFL nesting habitat (R. Evans, personal communication, 30 April 2014). Sightings or observed breeding activity of SWFL at Vandenberg AFB has not been documented since 2004.

Least Bell's Vireo

There will be no effect on least Bell's vireo as a result of the Proposed Action. There are no breeding records for least Bell's vireo on Vandenberg AFB, and there are only two documented records of occurrence, both of which are east of the 13th Street Bridge. Both of these records are more than 10 years old (Holmgren and Collins 1999). Riparian point count surveys conducted over the past 10 years have not documented this species on Vandenberg AFB (Seavy et al. 2012); therefore, this species would not be affected by project activities.

7.0 Effects of the Proposed Action on Federally Listed Species and Potential Habitat

7.1 Effects to El Segundo Blue Butterfly

Some seacliff buckwheat, host plant for ESBB, may be lost due to activities associated with clearing and grubbing of vegetation. Destroying or damaging buckwheat plants during the June through early September flight season when eggs or larvae may be present could result in mortality of these life stages. Vehicle traffic and other activities causing soil compaction have the potential to crush diapausing pupae already present, especially in proximity to seacliff buckwheat. Permanent removal of seacliff buckwheat would eliminate potential habitat for ESBB within the project area.

Adult butterflies may be struck directly by vehicles driving on roads or conducting construction activities during the flight season. However, removing vegetation and constructing new access roads would occur outside of the ESBB flight season, if feasible.

7.2 Effects to California Red-legged Frog

Suitable CRLF breeding and upland habitat on Vandenberg AFB is extensive. However, breeding habitat for CRLF does not occur within the project site, and the Proposed Action would not occur in standing or flowing water that would provide habitat for eggs or juveniles. Since the Proposed Action may take place during the wet season, the intermittent CRLF habitat in nearby Spring Canyon may contain water at the time of construction activities and/or the landing of the Falcon 9 vehicle. Frogs dispersing from Spring Canyon have the potential to enter SLC-4W during construction activities or a landing event during the wet season.

Storm water and water used for FireX system tests will be directed to an infiltration area, so no discharge to Spring Canyon will occur as part of the Proposed Action. Storm water will be directed into the infiltration area with a concrete v-ditch around the landing pad. Runoff that collects in the infiltration area will infiltrate within 72 hours. The infiltration area will be designed so that it will not hold water and will not be suitable for CRLF occupancy. Runoff that collects on the temporary panels will sheet flow to the nearest edge of the panel and infiltrate on site. There will be no significant effects to water quantity or quality.

No artificial lighting will be installed as part of the Proposed Action. Artificial light may disorient nocturnal animals, such as frogs, and can cause a reduction in visual capability with a recovery time of minutes to hours. Rapid increases in light can even cause blindness in wildlife

(Longcore and Rich 2004). The temporary scaffolding would be covered with temporary panels for the purpose of radio frequency reflection (i.e., not reflective of sunlight). The landing will occur during daytime and one engine will be lit for approximately 15 seconds during landing at the pad.

No toxic chemical deposition should occur as a result of the Proposed Action. Landing would occur on the concrete pad that will have perimeter control for storm water; therefore, even in the event of an anomaly all fuel used on the rocket should be contained. SRMs would not be used. The propellants to be used are liquid; therefore, there would be no acid deposition. There should be no significant effects to water quantity or quality.

For reasons described in more detail in Section 7.1, we anticipate no impacts (except noise and visual disturbance) to occur beyond the proposed footprint of the landing pad during the landing of the first stage vehicle. Constructing the landing pad, and landing the first-stage are expected to create noise.

Construction noise impacts to wildlife may result from short-term noise generated by mechanized equipment such as backhoes, concrete mixer trucks, dozers, dump trucks, excavators, loaders, graders, pavers, and rollers. Responses to noise are species-specific and can include physiological or behavioral responses. Amphibians have variable hearing capacities specialized for the perception of social and other meaningful signals. Amphibians are also sensitive to vibration. Vibration and noise associated with construction activities would potentially cause short-term impacts to amphibians, in particular, during breeding periods.

Noise during the construction phase would be fairly continuous and would generate between 80 to 85 dBA at 50 feet from the source. Spring Creek is approximately 200 feet away from the southern perimeter of SLC-4W and is approximately 600 feet away from the proposed construction area. The standard reduction for point source noise is 6 dBA per doubling of distance from the source. Based on the standard, at 200 feet noise levels would be 68 to 73 dBA. At 600 feet, noise levels would be under 65 dBA. However, due to the topography and vegetation, additional attenuation is expected. Construction is anticipated to take 90 to 120 days. During 30 days of this construction, concrete would be curing and minimal construction activities and noise would occur.

Landing noise may also impact CRLF. Frogs may respond to elevated noise levels by remaining immobile as a result of fear-induced paralysis (AMEC Americas Limited 2005). This response to noise may make frogs more susceptible to predation. However, we expect that frogs would dive underwater where they would be less susceptible to acoustic effects because the sound levels would be attenuated underwater (USFWS 2011a). Also, landing noise would be of short duration (approximately 4.6 minutes).

Landing would also generate a sonic boom. As shown in Figure 6, Spring Canyon would experience a sonic boom of approximately 0.6 psf. Honda Canyon would experience a sonic boom of approximately 0.6 to 0.7 psf, and Bear Creek would experience a sonic boom of 0.6 psf or less. The effects of noise generated during the non-breeding season would likely be minor because CRLF spend most of their lives in and near sheltered backwaters of ponds, marshes, springs, streams, and reservoirs. The effects during the breeding season could be more substantial because landing noise, including the associated sonic boom, could interfere with CRLF breeding activities. Male CRLF produce mating calls to attract females. These mating calls can be heard during the evening and at night, and sometimes during the daytime during peak breeding season (CaliforniaHerps.com 2014). In general, noise effect thresholds for most species are unknown, evidence for habituation is limited, long-term effects are generally unknown, and how observed behavioral and physiological responses might be manifested ecologically and demographically are poorly understood (Brown 2001).

An animal's response to noise can depend on a variety of factors, including noise level, frequency distribution, duration, number of events, variation over time, rate of onset, level of background noise, time of year, and time of day. A review of the literature reveals that it is generally accepted that reptiles, amphibians, and invertebrates do not hear as well as and react less than birds and mammals, although research is limited (U.S. Department of Transportation 2004). Spadefoot toads (*Scaphiopus couchi*) undergoing estivation reacted to motorcycle sounds (up to 95 decibels at 0.4-4.4 kilohertz) by leaving their burrows, which could have a detrimental effect if it occurred at the wrong time of year (Brattstrom and Bondello 1983). Other than this one study, however, there is little information on the response of amphibians to noise disturbance.

7.3 Effects to California Least Tern

As shown in Figure 1, landing noise expected at Purisima Point is approximately 70 to 80 dBA and 80 to 90 dBA at the Santa Ynez River mouth. If noise elicits a startle response during the nesting season, eggs may be abandoned and/or dislodged from the nest cup by retreating parents, and chicks may be left unattended and face increased risk from the elements or predation. Noise may also affect wildlife species physiologically or behaviorally. Physiological responses of birds include an increased heart rate, altering of metabolism and hormone balance, and behavioral reactions, such as head raising, body shifting, moving short distances, and flapping of wings. These responses may cause energy expenditure, reduced feeding, habitat avoidance, reproductive losses, and bodily injury (Radle 2007).

The sonic boom is expected to be less than 0.6 psf near Purisima Point and the Santa Ynez River mouth, as shown in Figure 6. Therefore, the sonic boom may generate impacts to CLTE if present during the Proposed Action. Noise associated with sonic booms has caused birds to panic and fly from nests, which has resulted in eggs becoming ejected from the nest or left open to predation and neglect in the parent's absence (Radle 2007). In 1969, sooty terns were observed to react to sonic booms from military aircraft by rising in a "panic flight" and then returning to their eggs. Hatching was normal during this same year (Wyle undated).

Visual disturbance of the landing is anticipated to be negligible due to the distance between the first stage vehicle and Purisima Point and the Santa Ynez River mouth. In addition, the first stage vehicle would remain above 1,000 feet for the majority of the landing. It is only anticipated that less than 5 seconds would be flown below 1,000 feet.

7.4 Effects to Western Snowy Plover

WSPL nesting locations do not occur within the project site or overflight zone. However, noise and visual disturbance from the landing may impact WSPL nesting areas by flushing adults, which can alert predators to the locations of nests and adults and expose nests or chicks to predation or adverse weather conditions. WSPL may be impacted by landing noise from the first stage vehicle landing. The southernmost WSPL nesting habitat may experience landing noise in excess of 100 dBA, as shown in Figure 1. The sonic boom is expected to be less than 0.6 psf in WSPL nesting habitat areas along the Vandenberg AFB coastline, as shown in Figure 6.

WSPL may also be impacted by the sonic boom that is anticipated during the first stage vehicle landing. Noise associated with sonic booms has caused birds to panic and fly from nests, which has resulted in eggs becoming ejected from the nest or left open to predation and neglect in the parent's absence (Radle 2007). Adults would be expected to return to their nests after being flushed (Wyle undated). Laboratory tests have concluded that sonic booms would not damage

an avian egg after eggs were exposed to sonic booms and other impulsive noises and were not structurally harmed (Wyle undated).

Visual disturbance of the landing may impact WSPL given that the overflight path of the first stage vehicle during landing is approximately 0.87 miles south of the closest known WSPL nesting location. However, the first stage vehicle would remain above 1,000 feet for the majority of the landing. We anticipate that only less than 5 seconds would be flown below 1,000 feet.

7.5 Effects to Southern Sea Otter

Landing noise, sonic boom, helicopter overflight, and boat and ship operations have the potential to result in direct and indirect effects on sea otters. In addition, visual impacts from the boost back and abort test may affect this species. Landing noise, sonic boom, and noise from helicopter overflights may affect sea otters by causing hearing damage or impairment, provoking temporary emigration, reducing energetic efficiency, and reducing reproductive success.

Areas where sea otters may be present would be impacted by launch noise between 70 and 100 dBA, as shown in Figure 1. Also, the sea otter rafting areas near Purisima Point and Sudden Flats are projected to have a sonic boom of 0.6 psf or less, as shown in Figure 6. Although there is limited data on the response of sea otters to sonic booms, the sonic boom may cause a brief startle response in sea otters that would cause sea otters to temporarily submerge underwater (Wyle undated). Therefore, we anticipate that landing noise and the sonic boom will not adversely affect the southern sea otter.

Figure 1 also shows the marine mammal buffer area, which is the area between the Vandenberg AFB coastline and the 40 meter continental shelf, or the area where marine mammals are likely to be found traversing the coastline. Although sea otters primarily congregate in the rafting areas containing kelp beds, they are known to traverse the coastline in the marine mammal buffer area from Gaviota State Beach to Pigeon Point. During the 2013 spring census conducted by the U.S. Geological Survey (USGS), 2,899 sea otters were counted (USGS 2014). Given the large area in which they are known to occur and the low number of sea otters that occur in this area, sea otters occur at low densities within the marine mammal buffer area.

The abort test of the Dragon capsule would require the Dragon capsule to land in the Pacific Ocean within the marine mammal buffer area. The Dragon capsule is 3.6 meters in diameter and 2.8 meters high. It will splashdown at a speed of approximately 7.2 meters/second (16 miles per hour). Experts estimate that the radius of the splash of the Dragon capsule would be 24 to 30 feet, and the height of the splash would be approximately 10 to 15 feet based on visual observations of the Dragon drop test conducted on 12 August 2010 off the coast of Morro Bay, California (SpaceX.com). Given the slow speed of the Dragon capsule splashdown (due to the use of multiple parachutes), the small size of the capsule, the small size of the splash/wake that would be produced, and the low density of sea otters within the area, the likelihood of the Dragon capsule impacting a traversing sea otter is minimal; therefore, this action is not likely to adversely affect the southern sea otter.

The Dragon recovery would require a helicopter or boat to recover the Dragon and transport the capsule to the Vandenberg AFB harbor. Since southern sea otters have the potential to occur within the Vandenberg AFB harbor, measures would be implemented to minimize disturbances to sea otters present in the harbor. If a helicopter is used to recover the Dragon, the helicopter would remain at an altitude over 1,000 feet unless actively retrieving (offshore) or cradling (at the Vandenberg Harbor) the Dragon. If a boat is used to recover the Dragon, watercraft would travel slowly upon entering the Vandenberg AFB harbor to the point where no wake would be

formed (approximately 2 to 3 knots). Therefore, a helicopter or boat recovering the Dragon capsule and transporting it to the Vandenberg harbor is not likely to negatively affect sea otters.

8.0 Analysis of Effects of the Proposed Action on Federally Listed Species

8.1 El Segundo Blue Butterfly

Project activities, including construction activities and site maintenance, such as mowing, could result in direct effects to ESBB. After the one-time Dragon capsule recovery and first stage vehicle landing event, access roads and mowed areas would be maintained, which would include permanently removing seacliff buckwheat, host plant for ESBB.

Due to the relatively small size of habitat within the project site, extensive distribution of seacliff buckwheat on Vandenberg AFB and throughout the species range, any potential loss of habitat within the project site is unlikely to significantly impact Vandenberg AFB populations of ESBB. Suitable habitat for ESBB would be enhanced at a 2:1 ratio in a nearby area to offset adverse effects of project activities.

8.2 California Red-legged Frog

Construction activities will not occur within aquatic and riparian habitats where CRLF is likely to occur. However, CRLF may be impacted by construction and landing noise, visual disturbance, and sonic boom.

Due to the fact that landing related noise and sonic boom will be of short duration, the distance of CRLF localities from the landing site, and the ability of water to buffer sound, injury to CRLF hearing is highly unlikely as a result of the boost-back; any disruption of CRLF behaviors would be of short duration and temporary. CRLF monitoring, consisting of pre- and post-launch counts and observations, was conducted within Bear Creek pursuant to monitoring requirements for the 8 September 2001 launch of an Atlas IIAS MLV-10 from SLC-3E. The launch site is approximately 1.5 miles from where CRLF were observed. Post-launch counts were within the range of pre-launch counts and no evidence of mortality, injury or abnormal behavior was observed in CRLF post-launch (SRS 2001b).

Frogs dispersing from Spring Creek have the potential to enter the project site during construction activities or the landing event, which could result in injury or mortality. To minimize adverse impacts to this species, silt fencing will be installed between the project site and Spring Creek, and a USFWS-approved biologist will conduct daily pre-construction surveys, and inspect trenches and any CRLF located in harm's way would be relocated to nearby suitable habitat.

8.3 California Least Tern

If the Proposed Action occurs during the nesting season, CLTE may potentially be impacted by vehicle landing noise and sonic boom. CLTE is the only species on Vandenberg AFB that has shown significant launch related disturbance. Launch activities from VAFB have resulted in CLTE emigrating from their breeding site when a launch occurred within 0.5 mile of the breeding site. Depending upon when the launch activity occurs related to the stage CLTE are in their nesting cycle seems to have different effects. At the beginning of the nesting season adults tend to be more readily disturbed, but once serious courtship and nest-building begins the

adults are more tenacious. During monitoring of the May and July 1997 launches of Delta IIs, the abandonment of up to five nests and the death of a chick due to exposure were observed. These two launches of Delta II vehicles from SLC-2 during the 1997 breeding season caused reduced nesting and reproductive success (USFWS 2011b).

To date no launches originating from South Base have occurred during the CLTE nesting season for which a monitoring requirement has been in place. We do not know how nesting CLTE will respond to landing noise within the 70 to 80 dBA range or sonic boom. A sonic boom could cause a startle response and result in CLTE abandoning the breeding colony, dislodged or damaged eggs, and temporarily abandoned nests if the boost-back and landing occurs during the breeding season. However, we anticipate project activities to occur outside of the breeding season. Since the Proposed Action will happen only a few minutes after the Falcon 9 launch, the proposed monitoring measures would be implemented to better understand landing noise and sonic boom effects on this species.

8.4 Western Snowy Plover

Extensive launch related monitoring of WSPL populations has been conducted on Vandenberg AFB, including observations during Titan IV and Falcon 9 launches from SLC-4E which represent larger, louder vehicles than the boost-back. WSPL showed no detectable adverse response to disturbance related to these launches (Robinette and Ball 2013). However, the sonic boom is expected to be 0.6 psf or less for WSPL habitat along the south and north Vandenberg AFB coastline. A sonic boom could cause a startle response and result in dislodged or damaged eggs and temporarily abandoned nests if the boost-back and landing occurs during the breeding season. However, we anticipate project activities will occur outside of the breeding season. If the boost-back and landing occurs during the breeding season, monitoring measures would be implemented to better understand sonic boom effects on this species.

8.5 Southern Sea Otter

There has been extensive launch monitoring of sea otters on both north and south Vandenberg AFB. Pre- and post-launch counts and observations have been conducted at rafting sites immediately south of Purisima Point for larger and louder launches from SLC-2, SLC-576E (Taurus launch pad), and at the rafting sites off of Sudden Flats for two Delta IV launches from SLC-6. No mortality or injury has ever been documented as a result of launch related disturbance (SRS 2006a, 2006c, 2006d, 2006e, 2006g, 2006h, 2007; MSRS 2007a, 2007b, 2007c, 2008a, 2008b, 2008c, 2008d, 2008e, 2009c, 2009d, 2010c). Monitoring indicates launch noise and security overflights do not substantially affect the number or activities of this species in the near shore marine environments of Vandenberg AFB. The boost-back is not anticipated to generate noise levels greater than previous launches for which southern sea otters have been monitored.

The sonic boom forecasted to affect the known southern sea otter rafting areas at Purisima Point and Sudden Flats would be 0.6 psf or less. Southern sea otters have not been previously monitored within areas impacted by sonic boom from launches originating from Vandenberg AFB. A sonic boom could cause a temporary startle response; however, we do not anticipate mortality or injury to occur.

During the Dragon recovery, the helicopter would remain at an altitude over 1,000 feet except when picking up the capsule in the ocean and cradling the Dragon in the harbor. If the Dragon were to be towed by marine vessel, it would enter the harbor at slow speeds (approximately 2 to

3 knots). These actions would minimize visual and noise disturbances to the sea otter. Therefore, the Proposed Action may affect but is not likely to adversely affect southern sea otter.

9.0 Cumulative Effects

Cumulative effects include the effects of future State, tribal, local, or private actions that are reasonably certain to occur in the action area. Future Federal actions unrelated to the Proposed Action would require separate consultation under section 7 of the ESA. No other anticipated significant projects are planned at any of these sites and no cumulative effects are anticipated from this project.

10.0 Interrelated and Interdependent Effects

There are no interrelated and/or interdependent effects anticipated to occur in relation to the Proposed Action.

11.0 Conclusion

Based on the analysis summarized above, the project may affect and is likely to adversely affect the ESBB, CLTE, WSPL, and CRLF. The Proposed Action may also affect but is not likely to adversely affect southern sea otter. However because of the minimization and monitoring measures that will be implemented, adverse effects to these species within the project area will be minimized.

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United States Department of the Interior

FISH AND WILDLIFE SERVICE
Ventura Fish and Wildlife Office
2493 Portola Road, Suite B
Ventura, California 93003

IN REPLY REFER TO:
08EVEN00-2014-F-0412

December 22, 2014

Beatrice L. Kephart
30 CES/CEI
1028 Iceland Avenue
Vandenberg Air Force Base, California 93437-6010

Subject: Biological Opinion for In-Flight Abort Test and Improvements to Space Launch Complex 4 West (SLC-4W), Vandenberg Air Force Base, Santa Barbara County, California (8-8-14-F-41)

Dear Ms. Kephart:

This document transmits the U.S. Fish and Wildlife Service's (Service) biological opinion based on our review of the proposed in-flight abort test and improvements at Space Launch Complex 4 West (SLC-4W) at Vandenberg Air Force Base (AFB) and its effects on the federally threatened California red-legged frog (*Rana draytonii*) and the endangered El Segundo blue butterfly (*Euphilotes battoides allyni*), in accordance with section 7 of the Endangered Species Act (Act) of 1973, as amended (16 U.S.C. 1531 et seq.).

Your original request included a determination that the proposed actions would likely adversely affect the federally threatened western snowy plover (*Charadrius nivosus nivosus*) and endangered California least tern (*Sterna antillarum browni*), but subsequent changes to the project eliminated those effects. You also determined that the proposed activities may affect, but not likely adversely affect the federally threatened southern sea otter (*Enhydra lutris nereis*). The Air Force and Space X have committed to incorporate measures into the project description (included in the Description of the Proposed Action below) that would avoid adversely affecting southern sea otters during activities at the harbor. Therefore, we concur with your determination that the proposed action is not likely to adversely affect southern sea otter, and we are not discussing this species further in this biological opinion. We received your request for formal consultation on July 22, 2014, and an amendment to the project description on October 28, 2014.

We based this biological opinion on information that accompanied your request for consultation, including the biological assessment (Tetra Tech Inc. 2014) and electronic and telephone communications between our staffs and information in our files. We can make available a complete record of this consultation at the Ventura Fish and Wildlife Office.

CONSULTATION HISTORY

Space Exploration Technologies (SpaceX) is a commercial space transport services company currently operating the Falcon Launch Vehicle Program at Space Launch Complex 4 East (SLC-4E) at Vandenberg AFB. We previously completed biological opinions regarding the effects of operations performed to

support this launch program (Service 2010, Service 2011a) at SLC-4E. In our biological opinion dated December 10, 2010, we concurred that launch noise and visual disturbance from space vehicle launches from this facility may affect, but were not likely to adversely affect western snowy plover, California least tern or southern sea otter. We did anticipate that site improvements and ongoing landscaping the Air Force proposed for SLC-4E could adversely affect El Segundo blue butterfly by removing its host plant, seacliff buckwheat (*Eriogonum parvifolium*). However, the in-flight abort test and site improvements currently proposed for SLC-4W were not anticipated at the time we conducted the consultation. On both June 24, 2011, and August 29, 2014, we concurred with your determination that launch activities at SLC-4E would not likely adversely affect California red-legged frogs.

We analyzed the impacts of maintaining the firebreaks surrounding both SLC-4E and SLC-4W in our programmatic biological opinion for routine operations and maintenance activities at Vandenberg AFB (Service 2011b).

On July 22, 2014, we received the Air Force's request for formal consultation for SpaceX's proposed activities, which included the in-flight abort test and SLC-4W site improvements, and a launch and subsequent landing of their boost-back launch vehicle at SLC-4W. On October 28, 2014, we received your request to modify the original project description, removing the landing activities because SpaceX would now land their boost-back vehicle on a barge 311 miles (500 kilometers) off the coast rather than at SLC-4W. On December 10, 2014, we provided the Air Force with a draft biological opinion.

BIOLOGICAL OPINION

DESCRIPTION OF THE PROPOSED ACTION

SpaceX proposes to perform an in-flight abort test of the Dragon capsule during an operational check of their boost-back launch vehicle. SpaceX would conduct the abort test during a launch tentatively scheduled for March 2015, but the launch has the potential to occur any time throughout the year. To accommodate future landings of the first stage of the boost-back vehicle at Vandenberg AFB, SpaceX also proposes constructing a 300-foot (91.4 meter) diameter concrete pad at SLC-4W. A complete project description is included in the Biological Assessment (Tetra Tech, Inc. 2014) and subsequent email communication (York 2014). Below is a summary of the aspects of the action relevant to our analysis.

In-Flight Abort Test

The Dragon capsule is a specialized payload (carried by the Falcon vehicle) that is comprised of a pressurized capsule and unpressurized trunk, thereby capable of carrying pressurized and unpressurized cargo, as well as humans. The Dragon capsule is 11.8 feet (3.6 meters) in diameter and 9.2 feet (2.8 meters) high. After launch, approximately 60 seconds into flight at Mach 1, the Dragon and its trunk would be released and SpaceX would initiate the launch escape system. After separation, the Dragon would initiate a course directly west (toward the ocean) from the launch vehicle. The thrusters would burn to completion at a constant rate of thrust to ensure the Dragon reaches a safe distance away from the Falcon 9 first stage and to achieve a suitable water landing. Dragon splashdown is anticipated to be 4 to 6 nautical miles (7.4 to 11.1 kilometers) offshore; the trunk landing is anticipated to be, at a minimum, equal to the distance from shore as the Dragon capsule or at maximum up to twice the distance. The anticipated splashdown speed of the Dragon capsule would be 16 miles per hour (25.7 kilometers/hour). SpaceX anticipates that only residual propellant would be inside the fuel tanks when the Dragon makes its water landing. The Dragon's trunk contains no active electrical or pressure systems and would only contain dummy weight for ballast to replicate nominal operational weights.

To recover the Dragon after splashdown, SpaceX would use a commercial provider to utilize a vessel capable of executing fast, safe recovery. SpaceX would plan this one-time test recovery as a daylight operation. SpaceX would recover the Dragon capsule using a 100-foot (30.5-meter) ship that would originate from Long Beach Harbor. Offshore, the ship would maintain a speed of 8 nautical miles per hour (15 kilometers/hour). A smaller boat, such as a 21-foot (6.4-meter) ASIS center console boat or 18-foot (5.5-meter) Nautica wide body, would accompany the ship and assist in inspecting the Dragon capsule after splashdown. SpaceX would have the capsule brought directly to the Long Beach Harbor unless they determine further processing is necessary, in which case it will be brought into the Vandenberg AFB harbor. If the capsule is brought into the Vandenberg AFB harbor, ship speed would be reduced to approximately 2 to 3 knots (2.3 to 3.4 miles per hour) within 1,000 feet (305 meters) of the harbor. All vessel speeds would be monitored using a Global Positioning System (GPS). SpaceX will not bring the capsule within depths of 131 feet (40 meters) until all vapors have dissipated. SpaceX would transfer the Dragon to a truck trailer using a crane. SpaceX would then transport the Dragon to a processing location within the harbor area for hypergolic fuel offloading activities. A proposed minimization measure requires any fuel offload and final transport measures occur over secondary containment.

SLC-4W Improvements

SLC-4W is approximately 33 acres (13.4 hectares), 9.1 acres (3.7 hectares) of which are developed, 21.9 acres (8.8 hectares) are non-native grassland, and 2.0 acres (0.8 hectares) are a mix of Central Coast Scrub and non-native grassland (Figure1). The proposed action includes constructing a 300-foot (91.4 meters) diameter concrete pad at the current SLC-4W site. Because there is no flat area within SLC-4W that can support a landing pad without grading, SpaceX would relocate and level up to 25,000 cubic yards (19,114 cubic meters) of soil, but would not require any imported fill material. No soil would be transported off-site. The landing pad would be approximately 70,650 square feet (1.6 acres; 0.65 hectares) and constructed over a combination of non-native grassland and previously developed areas. No artificial lighting would be installed at the landing pad.

SpaceX would develop two new access roads as part of the launch complex improvements. The access roads would be graded and would be composed of compacted base material. The access roads would be constructed over 0.38 acres (0.15 hectares) of non-native grassland and 0.034 acres (0.014 hectares) of central coast scrub/non-native grassland. SpaceX would mow the approximately 24 acres (9.7 hectares) of vegetation within the launch site fence line regularly to decrease grass and shrub mass around the landing pad. (The maintenance of the firebreak surrounding SLC-4W is already addressed in our Biological Opinion for routine mission operations and maintenance (Service 2011b)).

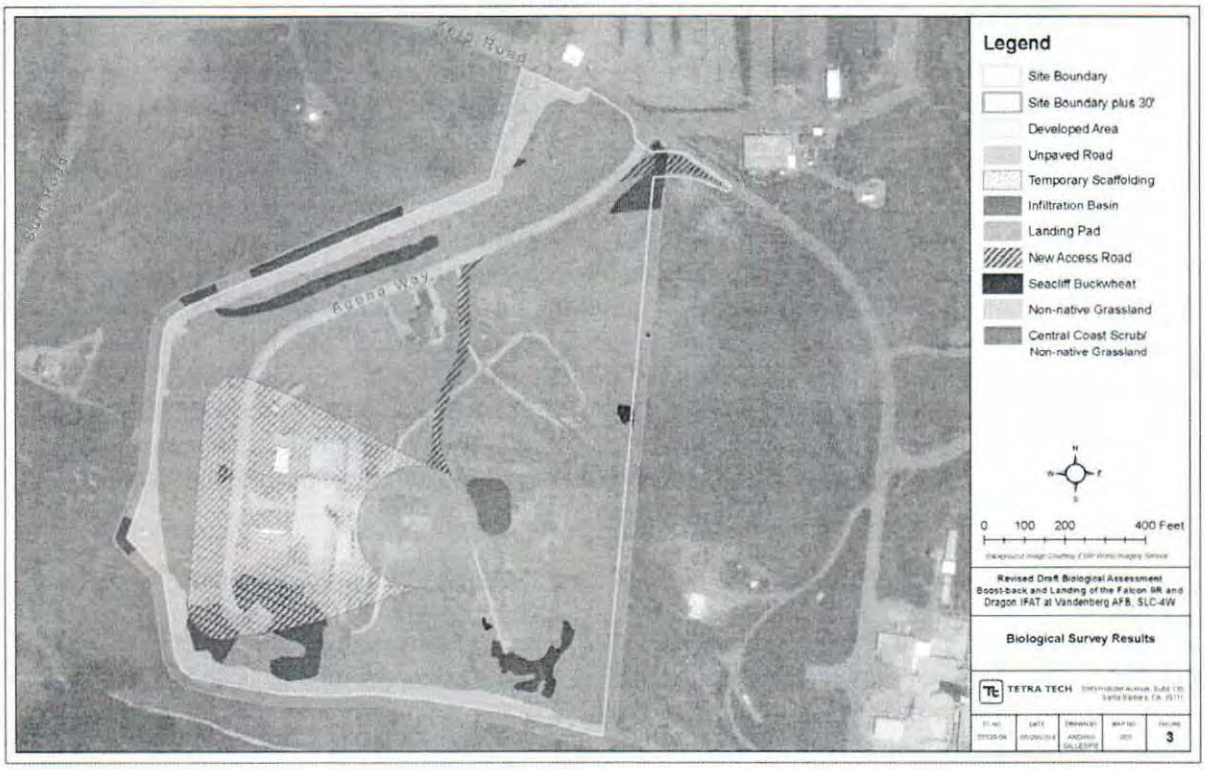

Figure 1. Space Launch Complex 4-West (SLC-4W) site improvements (Figure 3 from Tetra Tech, Inc., 2014).

Space X would construct a fire control system (FireX) with 3 or 4 remote controlled water cannons mounted on posts above ground to allow for remote firefighting capabilities; trenching would be required to tie into the existing water system, which would require trenching. Trenching would be performed within already developed site areas and would not exceed 4 feet (1.2 meters) in depth and 1 foot (0.3 meters) in width.

Construction is anticipated to take 90 to 120 days. During 30 days of this construction, concrete would be curing and minimal construction activities and noise would occur. Construction noise would remain under 90 A-weighted decibel scale (dBA) during construction.[1]

Avoidance and Minimization Measures

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[1] Sound is technically a pressure fluctuation in the atmosphere and ears respond to sound pressure in a logarithmic manner. Sound pressure levels are measured with the logarithmic scale, which corresponds to the biological properties of the human ear that determine sound loudness perception, with zero being the level sound the human ear can hear and a value of 120 dB is approximately the point at which the sound becomes painful. The "A-weighting" system is standardized such that low-frequency sounds are weighted lower than high frequency tones because the human ear (and the ears of some other animals) are less sensitive to the lower frequencies (Manci et al. 1988).

To minimize adverse effects to the California red-legged frog and El Segundo blue butterfly, the Air Force will ensure that SpaceX implements the following protective measures.

California red-legged frog

1. If construction activities are conducted during the wet season and water is present in Spring Canyon, a qualified biologist will conduct daily pre-construction surveys to ensure that dispersing frogs have not entered the project site.

2. If trenching activities occur during the wet season, a qualified biologist will inspect open trenches at the end of the day for the presence of California red-legged frogs, cover trenches at night, and inspect them in the morning to determine whether frogs have inadvertently become trapped in the trenches.

3. A Service-approved biologist will relocate all life stages of California red-legged frogs found within the project site to the nearest suitable habitat outside of the project site but within the same watershed.

4. SpaceX will install silt fence between the project site and Spring Creek to ensure no siltation occurs and to minimize dispersing frogs entering the project site.

El Segundo blue butterfly

1. El Segundo blue butterfly habitat will be enhanced at a 2:1 ratio (habitat enhanced: habitat affected). Enhancement activities will include herbicide treatment and hand removal of invasive species, planting native seedlings, and sowing native seed. Herbicides will not be applied during the flight season. Service-approved biologists will collect native seed for sowing and propagating buckwheat seedlings.

ANALYTICAL FRAMEWORK FOR THE JEOPARDY DETERMINATION

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

The jeopardy analysis in this biological opinion relies on four components: (1) the Status of the Species, which describes the range-wide condition of California red-legged frog and El Segundo blue butterfly, the factors responsible for that condition, and the species' survival and recovery needs; (2) the Environmental Baseline, which analyzes the condition of California red-legged frog and El Segundo blue butterfly in the action area, the factors responsible for that condition, and the relationship of the action area to the survival and recovery of these species; (3) the Effects of the Action, which determines the direct and indirect impacts of the proposed Federal action and the effects of any interrelated or interdependent activities on California red-legged frog and El Segundo blue butterfly; and (4) the Cumulative Effects, which evaluates the effects of future, non-Federal activities in the action area on California red-legged frog and El Segundo blue butterfly.

In accordance with policy and regulation, the jeopardy determination is made by evaluating the effects of the proposed federal action in the context of the current status of California red-legged frog and El Segundo blue butterfly, taking into account any cumulative effects, to determine if implementation of the proposed action is likely to cause an appreciable reduction in the likelihood of both the survival and recovery of these species in the wild.

STATUS OF THE SPECIES

California Red-legged Frog

The California red-legged frog was federally listed as threatened on May 23, 1996 (61 FR 25813). The Service completed a recovery plan for the species in 2002 (Service 2002). A 5-year review for the California red-legged frog has not been completed. The historical range of the California red-legged frog extended coastally from southern Mendocino County and inland from the vicinity of Redding, California, southward to northwestern Baja California, Mexico (Jennings and Hayes 1985, Storer 1925). The California red-legged frog has been extirpated or nearly extirpated from 70 percent of its former range. Historically, this subspecies was found throughout the Central Valley and Sierra Nevada foothills. Four additional occurrences have been recorded in the Sierra Nevada foothills since listing, bringing the total to five extant populations in that area compared to approximately 26 historical records (61 FR 25813). Currently, California red-legged frogs are known from three disjunct regions in 26 California counties and one region in Baja California, Mexico (Grismer 2002; Fidenci 2004; and Smith and Krofta, 2005). The diet of California red-legged frogs is highly variable. Hayes and Tennant (1985) found invertebrates to be the most common food item of adults. Vertebrates, such as Pacific chorus frogs (*Pseudacris regilla*) and California mice (*Peromyscus californicus*), represented over half of the prey mass eaten by larger frogs (Hayes and Tennant 1985). Hayes and Tennant (1985) found juveniles to be active diurnally and nocturnally, whereas adults were largely nocturnal.

California red-legged frogs breed from November through March; earlier breeding has been recorded in southern localities (Storer 1925). Males appear at breeding sites from 2 to 4 weeks before females (Storer 1925). Female California red-legged frogs deposit egg masses on emergent vegetation so that the masses float on the surface of the water (Hayes and Miyamoto 1984). Egg masses contain about 2,000 to 5,000 moderately-sized, dark reddish brown eggs (Storer 1925, Jennings and Hayes 1985). Eggs hatch in 6 to 14 days (Storer 1925). Larvae undergo metamorphosis for 3.5 to 7 months after hatching (Storer 1925, Wright and Wright 1949). Sexual maturity can be attained at 2 years of age by males and 3 years of age by females (Jennings and Hayes 1985); adults may live 8 to 10 years (Jennings et al. 1992) although the average life span is considered to be much lower. The California red-legged frog is a relatively large aquatic frog ranging from 1.5 to 5 inches (3.8 to 5.1 centimeters) from the tip of the snout to the vent (Stebbins 2003).

The California red-legged frog uses a variety of habitat types, including various aquatic systems, riparian, and upland habitats. Tadpoles, juveniles, and adults have been collected from streams, creeks, ponds, marshes, plunge pools and backwaters of streams, dune ponds, lagoons, and estuaries. California red-legged frogs frequently breed in artificial impoundments such as stock ponds, if conditions are appropriate. Although California red-legged frogs successfully breed in streams and riparian systems, high seasonal flows and cold temperatures in streams often make these sites risky environments for eggs and tadpoles. The importance of riparian vegetation for this species is not well understood. When riparian vegetation is present, California red-legged frogs spend considerable time resting and feeding in it; the moisture and camouflage provided by the riparian plant community provide good foraging habitat and may facilitate dispersal in addition to providing pools and backwater aquatic areas for breeding.

Juvenile and adult California red-legged frogs may disperse long distances from breeding sites throughout the year. They can be encountered living within streams at distances exceeding 1.8 miles from the nearest breeding site, and have been found up to 400 feet (122 meters) from water in adjacent dense riparian vegetation (Bulger et. al 2003). During periods of wet weather, starting with the first rains of fall, some individuals may make overland excursions through upland habitats. Most of these overland movements occur at night. Bulger et al. (2003) found marked California red-legged frogs in Santa Cruz County making overland movements between sites up to 1.7 miles (2.8 kilometers) apart. These individual frogs made long-distance movements that tended to be straight-line, point to point migrations over variable upland terrain rather than using riparian corridors for movement between habitats. For the California red-legged frog, suitable habitat is considered to include all aquatic and riparian areas within the range of the species and includes any landscape features that provide cover and moisture (61 FR 25813).
Habitat loss and degradation, combined with over-exploitation and introduction of exotic predators, were important factors in the decline of the California red-legged frog in the early to mid-1900s. Continuing threats to the California red-legged frog include direct habitat loss due to stream alteration and loss of aquatic habitat, indirect effects of expanding urbanization, competition or predation from non-native species including the bullfrog, catfish (*Ictalurus* spp.), bass (*Micropterus* spp.), mosquito fish (*Gambusia affinis*), red swamp crayfish (*Procambarus clarkia*), and signal crayfish (*Pacifasticus leniusculus*).

An additional threat affecting amphibians worldwide is the chytrid fungus *Batrachochytrium dendrobatidis*. *Batrachochytrium dendrobatidis* causes chytridiomycosis, a skin disease that has been found to disrupt osmoregulatory function in the skin of amphibians, resulting in an imbalance of electrolytes and death (Voyles et al. 2009). Chytridiomycosis in amphibians may be marked by deformed mouthparts in tadpoles, wherein most infected tadpoles will die at metamorphosis (Service 2002). Infected boreal toads (*Anaxyrus boreas boreas*) showed few clinical signs of the disease but many appeared weak or lethargic, exhibited excessive shedding of skin and were reluctant to flee at the approach of humans (U.S. Geological Survey 2000, as cited in Service 2002). Chytrid fungi are widespread in the environment where they act as decomposers of keratin, chitin, cellulose, and other plant material, and are known parasites of fungi, algae, higher plants, protozoa, invertebrates, and most recently in vertebrates. Chytrid fungi reproduce asexually by means of minute, fragile, motile spores, and are probably spread directly from amphibian to amphibian in water. These fungi most likely move from one water source to another on migrating amphibians, waterbirds, or flying insects (Service 2002).

Since its discovery in 1998, chytrid fungus has likely been responsible for die-offs of a number of amphibian species, including remaining populations of the endangered boreal toad in the southern Rocky Mountains, and Chiricahua leopard frogs (*Rana chiricahuensis*) in Arizona (Colorado Herpetological Society 2000, as cited in Service 2002). Occurrences of infection have been observed in two amphibian species in the Sierra Nevada, the mountain yellow-legged frog (*Rana muscosa*) and the Yosemite toad (*Bufo canorus*). An infected California red-legged frog tadpole was collected in Calabasas Pond on the Ellicott Slough National Wildlife Refuge in Santa Cruz County (Service 2002).

The chytrid fungus is now recognized for its ability to spread quickly through amphibian populations and infect numerous species, causing high rates of mortality, and persisting at low host densities (Voyles et al. 2009). These recent findings validate the importance of taking precautions to prevent the spread of chytrid fungus or any disease agent into and/or between amphibian populations. It is considered a threat to California red-legged frog populations.

Recovery Plan for the California Red-Legged Frog

According to the recovery plan for the California red-legged frog, the strategy for the species' recovery involves: (1) protecting existing populations by reducing threats; (2) restoring and creating habitat that will be protected and managed in perpetuity; (3) surveying and monitoring populations and conducting research on the biology and threats to the species; and (4) reestablishing populations of the species within its historical range (Service 2002).

The recovery plan for the California red-legged frog identifies eight recovery units. These recovery units are based on the Recovery Team's determination that various regional areas of the species' range are essential to its survival and recovery. The recovery status of the animal is considered within the scale of recovery units as opposed to the overall range. Because of the varied status of this species and differing levels of threats throughout its range, recovery strategies differ per recovery unit to best meet the goal of delisting the species. For example, in areas where California red-legged frog populations appear to be stable, recovery strategies are intended to protect existing population numbers, whereas in areas where frogs have been extirpated or are declining, strategies are to stabilize, increase, augment, or reestablish populations.

The recovery units are delineated by major watershed boundaries as defined by U.S. Geological Survey hydrologic units and the limits of the range of the California red-legged frog. The goal of the recovery plan is to protect the long-term viability of all extant populations within each recovery unit. Within each recovery unit, core areas have been delineated and represent contiguous areas of moderate to high California red-legged frog densities that are relatively free of exotic species such as bullfrogs. The goal of designating core areas is to protect metapopulations that, combined with suitable dispersal habitat, will allow for the long term viability of existing populations. This management strategy allows for the recolonization of habitat within and adjacent to core areas that are naturally subjected to periodic localized extirpations, thus assuring the long-term survival and recovery of the California red-legged frog.

El Segundo Blue Butterfly

The El Segundo blue butterfly was federally listed as endangered on June 1, 1976 (41 FR 22041). No critical habitat has been designated for El Segundo blue butterfly. We issued a recovery plan for the El Segundo blue butterfly on September 28, 1998 (Service 1998). A 5-year review was completed in 2008 (Service 2008).

Shields (1975) formally described the El Segundo blue butterfly based on specimens that had been collected in the city of El Segundo, California. The El Segundo blue butterfly is in the family Lycaenidae. It is one of five subspecies comprising the polytypic species, the square-spotted blue butterfly (*Euphilotes battoides*). Like all species in the genus *Euphilotes*, El Segundo blue butterfly spends its entire life cycle in intimate association with a species of buckwheat, in this case seacliff buckwheat. However, the nearly complete association of all life stages with a single plant is unique among North American butterflies. El Segundo blue butterfly adults mate, nectar, lay eggs, perch, and in most cases probably die on buckwheat flowerheads (Mattoni 1990).

The adult stage of El Segundo blue butterfly generally begins in early June and concludes in early to mid-September. The onset of this stage is closely synchronized with the beginning of the flowering season for seacliff buckwheat (Mattoni 1990; Pratt and Ballmer 1993). Typically, adult females may survive up to 2 weeks whereas a male may survive up to 7 days (Pratt, pers. comm. 2006a). Upon emergence as adults,

females fly to seacliff buckwheat flowerheads where they mate with males that are constantly moving among flowerheads (Service 1998).

Eggs are laid in seacliff buckwheat flowerheads and hatch within 3 to 5 days. The larvae then undergo four instars to complete growth, a process that takes 18 to 25 days (Service 1998). By the third instar, the larvae develop honey glands and are thereafter usually tended by ants (e.g., *Iridiomyrmex humilis*, *Conomyrmex* spp.), which may protect them from parasitoids (e.g., Branchoid wasp (*Cortesia* spp.)) and small predators (Mattoni 1990). Ant species that are associated with and tend El Segundo blue butterfly larvae include carpenter ants (*Camponotus maritimus*), pyramid ants or insane ants (*Dorymyrmex insanus*), formica or California red-and-black field ant (*Formica moki*), acrobat ants (*Crematogaster hesperus*), and odorous house ant, stink ant, or coconut ant (*Tapinoma sessile*) (Tetra Tech, Inc. and Pratt 2012). Larvae remain concealed within flowerheads and initially feed on pollen, then switch to feeding on seeds sometime during the first and second instar (Pratt, pers. comm. 2006a). Larvae are highly polymorphic, varying from almost pure white or yellow to strikingly marked individuals with a dull red-to-maroon background broken by a series of yellow or white dashes (Mattoni 1990).

At the end of the fourth instar, larvae disperse from the flowerheads, fall or crawl to the ground, and pupate in the soil. Larvae may find a suitable site directly underneath seacliff buckwheat plants or migrate (wander) away from the plant to a more suitable site. This wandering stage is short (likely 1 day or less). Larvae may travel up to approximately 25 feet (7.6 meters) from the nearest seacliff buckwheat plant, but we expect that most larvae would be found within the immediate vicinity of a seacliff buckwheat plant (Arnold, pers. comm. 2013a, b). We do not know the factors that make a site suitable, but it is known that the larvae pupate in sandy soils, clay soils, shale, sandstone, and even cracks and softer portions of road, and seem to prefer softer soils compared to harder substrates (Arnold, pers. comm. 2013a, b). Upon finding a suitable site, larvae burrow into the ground and remain there until the appropriate conditions are met. El Segundo blue butterfly are true pupae in that they are bags of fluid that contain a thick cuticle to protect it from moisture loss and other factors. At least 0.5 inch (1.3 centimeters) of rain must penetrate the soil to accumulate enough moisture for the pupae to undergo a life stage change (i.e., develop into an adult) (Pratt, pers. comm. 2006a). The adult butterfly emerges the following June; however, some pupae may remain in diapause for up to 6 years (Pratt pers. comm. 2013). Some pupae at every site likely remain in diapause each year (i.e., some pupae stay in diapause each year even in good years) (Arnold, pers. comm. 2013a, b).

Population dynamics of El Segundo blue butterflies are closely allied with the seacliff buckwheat. Although individual plants may live 20 years or more, young plants generally do not flower until their second year of growth (Arnold and Goins 1987). Juveniles and older plants do not produce as many flowers as middle-aged buckwheat plants, which support the most butterflies (Arnold and Goins 1987). Field observations suggest that solitary buckwheat plants less than about 5 years of age do not produce enough flowers for larvae to effectively utilize them (Arnold 1983). Thus, survival of El Segundo blue butterfly is dependent upon maintenance of middle-aged buckwheat plants and recruitment of younger plants to replace older individual plants that senesce.

For several decades following the subspecies' description, the El Segundo blue butterfly was presumed to be endemic to southwestern Los Angeles County in coastal southern California. Museum records reveal that the El Segundo blue butterfly was once widespread on the El Segundo sand dunes and specimens were collected at El Segundo, Redondo Beach, Manhattan Beach, and at several locations on the Palos Verdes peninsula (Donahue 1975). Currently, El Segundo blue butterfly occurs at four locations in Los Angeles County: the Ballona Wetlands, the Airport Dunes, the Chevron Preserve, and Malaga Cove. Four recovery units, based on geographic proximity, habitat similarity, and possible genetic exchange,

encompass these areas with the known populations and (or) areas with restorable habitat (Service 1998). The El Segundo blue butterfly appears further limited to areas with high sand content (Service 1998).

Seacliff buckwheat occurs over a larger range than the known range of El Segundo blue butterfly; seacliff buckwheat occurs from San Diego County to the northern end of Monterey County (Pratt, pers. comm. 2006b; Baldwin et al. 2012; CalFlora 2013). The southern extent of El Segundo blue butterfly's known distribution is Malaga Cove in Los Angeles County, and before it was discovered in Santa Barbara County in 2005, the northern extent of its known distribution was the Ballona Wetlands in Los Angeles County.

Population in Santa Barbara County

The El Segundo blue butterfly was reported to occur at Vandenberg AFB in 2005 by Dr. Gordon Pratt and by Dr. Pratt and Dr. Richard Arnold in 2007 (Pratt, pers. comm. 2006a; Bell, pers. comm. 2007). Questions were raised whether the butterflies observed at Vandenberg AFB are actually the El Segundo blue butterfly or a morphologically similar species. The genus *Euphilotes* is complex and diverse. There are known cases of cryptic speciation in the genus (i.e., some distantly related species are very similar morphologically) (Mattoni 1988). Wing characters are typically used to identify butterflies; however, they are not as useful in *Euphilotes* (as a genus) because these characters can vary between individuals within the same taxon (and particularly in the *E. battoides* complex). In these instances, additional information and other characters are necessary for a definitive identification such as larval host plant, genitalia morphology, flight season, location, and genetics (Ballmer, pers. comm. 2006).

Because butterflies in the genus Euphilotes can be very similar morphologically yet substantially different genetically (Mattoni 1990; Pratt 1994), individual male butterflies were collected to compare the genetic signatures among the butterflies from Vandenberg AFB with known El Segundo blue butterflies from Los Angeles County (Pratt and Stouthamer 2008). We have reviewed the results of the genetic study and determined that the resulting information was not conclusive enough to make a determination that the butterfly in question is not the El Segundo blue butterfly.

Given that the geographic separation between the known occurrences of El Segundo blue butterfly in Santa Barbara County and Los Angeles County is approximately 120 miles (193 kilometers) and the relatively limited dispersal capability of El Segundo blue butterfly, it is possible that the butterflies observed at Vandenberg AFB are not El Segundo blue butterfly but rather an undescribed, cryptic species that has the same morphology, larval food plant, flight season, and genitalia. On the contrary, it is possible that there was a continuous distribution between Santa Barbara and Los Angeles Counties but separated over time either naturally or by anthropogenic causes. This concept is supported by the distribution of seacliff buckwheat, the butterfly's limited dispersal capabilities, and the increasing fragmentation of native habitat in this region. A third possibility is that the butterflies currently have a continuous distribution between Santa Barbara and Los Angeles Counties, but have not yet been documented in the intervening areas. However, there are no areas known with El Segundo blue butterfly occurrences between the populations in Santa Barbara and Los Angeles Counties. A few species experts have opportunistically surveyed some of the intermediate sites that contain seacliff buckwheat, but these survey efforts have been infrequent and less rigorous. Moreover, another possibility is that El Segundo blue butterflies do not occupy the areas between Santa Barbara and Los Angeles Counties, but have dispersed from one area to another. A long-distance dispersal event is more likely to occur during one dispersal event rather than multiple events in a stepping-stone fashion because the probability of a single longer dispersal event is greater than the combined probability of two (or more) consecutive shorter dispersal events (Gillespie et al. 2012, Crisp *et al.* 2011). Strong wind events (e.g., Santa Ana winds,

hurricanes) are a widely recognized mechanism for successful long-distance dispersal events and are a vector for the successful colonization of islands by plants, animals (e.g., butterflies), and arthropods, which are generally less dispersive (Gillespie *et al.* 2012, Zimmerman 1948).

Based on wing morphology, flight period, genitalia, and host plant association; these individuals were determined to be more similar to El Segundo blue butterfly than to any other known *Euphilotes* species or *E. battoides* subtaxon (Ballmer, pers. comm. 2006; Pratt, pers. comm. 2006c). Therefore, we consider this species to be El Segundo blue butterfly until we receive definitive information demonstrating otherwise.

El Segundo blue butterfly was first known to occur at two general locations on Vandenberg AFB in Santa Barbara County (Tranquillon Mountain and San Antonio Terrace). In subsequent years El Segundo blue butterfly has also been reported to the northeast of San Antonio Terrace near Lompoc-Casmalia Road and northeast of the Vandenberg tracking station; East of the Base boundary near the northwestern portion of Burton Mesa Ecological Reserve along the Freeport-McMoran pipeline; East of Tranquillon Peak along Miguelito Canyon Road, East of Lompoc along Sweeney and Santa Rosa Roads; and even further east near Drum Canyon Road. Thus, El Segundo blue butterfly has been found in additional areas beyond those known to be occupied as surveys have been conducted over the last 6 years.

Arnold (1986) conducted capture-recapture studies in Los Angeles County and reported that the majority of El Segundo blue butterflies moved 100 feet (31 meters) or less between captures; 79 percent and 87 percent for females and males, respectively. Approximately 93 percent of females and males moved 200 feet (61 meters) or less between captures. Approximately 3 percent of females and 4 percent of males moved more than 500 feet (152 meters) between captures. The farthest distance moved by any individual butterfly was approximately 7,200 feet (1.36 miles; 2.18 km). However, we note that the 200-foot (61-meter) buffer was derived from studies at the Chevron Refinery (Chevron) in El Segundo. The Chevron site is approximately 1.5 acres (0.61 hectares) and is surrounded by urban areas. The area contains high concentrations of seacliff buckwheat plants that grow in close proximity to one another. Therefore, the adult El Segundo blue butterfly would not have to disperse very far to locate suitable seacliff buckwheat flowerheads. In contrast, the preserve at the Los Angeles International Airport (LAX) is 200 acres (81 hectares) and contains widely scattered seacliff buckwheat plants. At the LAX site, El Segundo blue butterflies were detected dispersing up to 1.36 miles (2.18 kilometers), and the average movement of individuals at LAX was more than twice that of individuals at the Chevron location (Arnold 1986). Additionally, adult El Segundo blue butterflies routinely dispersed up to 0.5 mile (0.8 kilometers) from occupied locations to colonize restoration sites in Los Angeles and Redondo Beach.

Because the El Segundo blue butterfly has been observed to disperse farther distances in larger areas that contain more widely scattered plants, the 200-foot (61-meter) buffer may represent the lower end of the dispersal distance capability of El Segundo blue butterfly. Therefore, based on the habitat and area at Vandenberg AFB, it could be expected that dispersal distance would be greater in Santa Barbara County where the seacliff buckwheat plants are much less dense than at Chevron, as it was at the LAX site compared to the Chevron site. However, we do not know the minimum, average, or maximum dispersal distances of El Segundo blue butterfly in Santa Barbara County.

To quantify the amount of occupied habitat on Vandenberg AFB, we took into account that the majority of individual El Segundo blue butterflies move 200 feet (61 meters) or less (Arnold 1986), and calculated a 200-foot buffer around each observed butterfly. We assume, however, the 200-foot (61-meter) buffer is at the lower end of observed dispersal distances for El Segundo blue butterflies when seacliff buckwheat plants are more scattered, such as at Vandenberg AFB (see discussion above regarding dispersal distances

(Arnold 1986)). Nevertheless, the estimate in 2013 is approximately 1,090 acres (441 hectares) of known occupied habitat at Vandenberg AFB (ManTech Technologies SRS Inc. and Arnold 2013). The Air Force estimated that approximately 17,500 acres (7,082 hectares) of suitable habitat is within 1 mile (1.6 kilometers) of the known occupied habitat, and the seacliff buckwheat is distributed over at least 60,000 acres (24,281 hectares) of the Base. Many of these areas contain seacliff buckwheat plants at low densities. The acreage estimates for suitable habitat do not include a 200-foot (61-meter) buffer; thus, calculations for known occupied and suitable habitats are not determined the same way.

Threats to El Segundo Blue Butterfly

In general, the El Segundo blue butterfly is negatively impacted by competition, predation, and parasitism by other insects utilizing seacliff buckwheat; loss of habitat and habitat fragmentation due to development; and loss of habitat due to competition of nonnative vegetation with seacliff buckwheat. Urbanization and land conversion have fragmented the historic range of the El Segundo blue butterfly such that extant populations now operate as independent units rather than parts of a metapopulation or a single, cohesive, wide-ranging population (Service 2008). Small populations have higher probabilities of extinction than larger populations because their low abundance renders them susceptible to inbreeding, loss of genetic variation, high variability in age and sex ratios, demographic stochasticity, and other random, naturally occurring events such as droughts or disease epidemics (Soulé 1987). Additionally, isolated populations are more susceptible to elimination by stochastic events because the likelihood of recolonization following such events is negatively correlated with the extent of isolation (Wilcox and Murphy 1985). Given the low dispersal potential of El Segundo blue butterflies, the likelihood that this subspecies would naturally recolonize a site decreases as the distance between the occupied sites increases. Therefore, if a site becomes extirpated and is a greater distance from an occupied site than the dispersal distance of El Segundo blue butterfly, it may not be recolonized. Habitat fragmentation is detrimental to small, isolated populations and produces edge effects that facilitate the introduction of invasive nonnative plant species that may out-compete and displace seacliff buckwheat. Relatively fast-growing invasive nonnative plants such as acacia (*Acacia* spp.), iceplant, other buckwheat species (*Eriogonum* spp.), and nonnative grasses compete with seacliff buckwheat and decrease the likelihood that seacliff buckwheat would sprout and mature (Mattoni 1990). Furthermore, Pratt (1987) observed numerous insects living in seacliff buckwheat inflorescences along with El Segundo blue butterfly larvae, including lepidopterous larvae in the families of Cochylidae, Gelechiidae, Geometridae, Riodinidae, and even other Lycaenidae. Parasitoids (e.g., Branchoid wasp (*Cortesia* spp.) and small predators may also affect El Segundo blue butterflies (Mattoni 1990).

Recovery of El Segundo Blue Butterfly

The recovery plan for El Segundo blue butterfly identifies four recovery units (RU) (Ballona, Airport, El Segundo, and Torrance) to conserve and maintain the species' distribution and its genetic diversity throughout its present range (Service 1998). At least one population in each of the four units is needed to reduce the risk of extinction from random events that may affect any one local area. We wrote the recovery plan for El Segundo blue butterfly prior to the discovery of the species on Vandenberg AFB, so it is not considered in the plan.

The recovery of El Segundo blue butterfly is dependent on protection of occupied and potential habitat. Occupied habitat contains individuals of the subspecies and associated habitat used for breeding, feeding, shelter, and/or as a dispersal corridor. Potential habitat consists of areas that contain El Segundo sand dune and are not currently occupied by the subspecies, but could be managed and restored. Colonization of potential areas by El Segundo blue butterfly would result in increased numbers of individuals,

ultimately expanding the number and size of populations until the subspecies reaches the point where it can be downlisted to threatened. According to the recovery plan (Service 1998), El Segundo blue butterfly can be considered for downlisting to threatened status when:

1. At least one secure population in each of the four RUs is permanently protected. The Airport Dunes located in the Airport RU contains the largest population of the butterfly and is the most likely one that can survive disease, predators, parasites, and other perturbations. The Airport Dunes must be one of the protected populations.

2. Each of the four populations are managed to maintain coastal dune habitat dominated by local native species including coast buckwheat.

3. As determined by a scientifically credible monitoring plan, each of the four populations must exhibit a statistically significant upward trend (based on transect counts) for at least 10 years (approximately 10 butterfly generations). Population management in each RU must ensure that discrete population growth rates are maintained at or above 1.0, indicating a stable or increasing population.

4. A program is initiated to inform the public about the El Segundo blue butterfly and its habitat.

5-Year Review for El Segundo Blue Butterfly

Subsequent to the listing of El Segundo blue butterfly and subsequent development of the recovery plan, and prior to the 5-year review, this subspecies was discovered on the Palos Verdes Peninsula and at Vandenberg AFB. Thus, these areas were not considered in the original listing document or the recovery plan. The 5-year review for the El Segundo blue butterfly states that the subspecies continues to be threatened by habitat degradation, habitat fragmentation; introduction of parasitic, competing and predatory insect species, and stochastic extinction. In consideration of its limited and fragmented distribution, overall small population size, and continued threats as discussed, the El Segundo blue butterfly remains in danger of extinction throughout all or a significant portion of its range. However, because of the recent success of habitat restoration efforts along Torrance, Redondo, and Dockweiler beaches (Los Angeles County) in 2007, we concluded that this subspecies can respond positively to management of its habitat and the recovery potential has improved.

ENVIRONMENTAL BASELINE

The implementing regulations for section 7(a)(2) of the Act define the "action area" as all areas to be affected directly or indirectly by the Federal action and not merely the immediate area involved in the action (50 CFR 402.02). For the purposes of this biological opinion, we consider one large action area for the two non-overlapping project components. The action area for the SLC-4W site improvements includes the area within the launch site fence and a 30-foot (9.1 meter) buffer in all directions, as well as the Spring Canyon drainage south of the site. The action area for the in-flight abort test includes all areas between SLC-4E, the ocean splash-down site (up to 12 nautical miles (22.2 kilometers) westward), and the Vandenberg AFB harbor.

California Red-legged Frog

Vandenberg Air Force Base is located in the relative middle of the current range of the California red-legged frog. Many of the healthiest populations of the species (in terms of numbers of individuals) area

located along the central coast of California, and California red-legged frogs are likely to be present in nearly all permanent streams and ponds on the base.

SLC-4W does not contain potential California red-legged frog breeding habitat and the nearest such habitat is located approximately 200 feet (61 meters) south of the SLC-4W southern boundary in Spring Canyon. Spring Canyon is an ephemeral drainage located on Vandenberg AFB immediately south of SLC-4 and has not contained water for the last 2 years due to drought conditions. Protocol-level surveys have not been conducted for California red-legged frogs within Spring Canyon; however, this species has potential to occur in various aquatic habitats, including natural and artificial ponds and reservoirs, streams and other watercourses, freshwater lagoons, springs, and seeps (Bulger et al. 2003).

SLC-4 is 1.53 miles (2.5 kilometers) south of the nearest documented California red-legged frog location and breeding habitat in the Bear Creek lagoon (SRS Technologies 2001). California red-legged frogs have also been documented in Honda Creek (1.9 miles (3.1 kilometers) south of SLC-4 (ManTech SRS Technologies, Inc. 2013).

Recovery of the California Red-legged Frog

The action area and Vandenberg Air Force Base in general are within the Northern Transverse Ranges and Tehachapi Mountains Recovery Unit for the California red-legged frog. The action area is also within the Santa Maria River-Santa Ynez River Core Area defined in the recovery plan (Service 2002). The recovery unit was described in the recovery plan as having a "high recovery status," meaning the unit supports many populations of the species, has many areas of high habitat quality, and threat levels that ranged from low to high. Some protections are afforded to the California red-legged frog on Vandenberg AFB due to implementation of the Air Force's Integrated Natural Resources Management Plan (INRMP) (U.S. Air Force 2011). So far, the Air Force has implemented several actions that provide a positive conservation benefit: (1) public outreach and education; (2) working with researchers from U.C. Santa Barbara, the U.S. Geological Survey, and Department of the Navy, including chytridiomycosis studies; (3) surveys for new populations; (4) monitoring of known populations; and other actions. These efforts are consistent with the goals from the recovery plan of protecting known populations; protecting suitable habitat, corridors, and core areas; developing land use guidelines; gathering biological and ecological data necessary for conservation of the species; and monitoring existing populations and conducting surveys for new populations.

El Segundo Blue Butterfly

Seacliff buckwheat plants occur sparsely within the areas surrounding SLC-4W and 118 individual plants were located within 0.04 acres (0.016 hectares) of the launch site complex during buckwheat surveys conducted in March, 2014 (Tetra Tech Inc. 2014)(Figure 1). SLC-4W is approximately 1.2 miles (1.9 kilometers) from the nearest known location of the El Segundo blue butterfly. This locality represents an isolated individual observed at Bear Creek and Coast Roads in 2008. Subsequent surveys in the area conducted in 2008, 2009, 2011, 2012, 2013, and 2014 failed to document additional El Segundo blue butterfly at the site (ManTech SRS Technologies Inc. and Arnold 2013). The closest recently documented El Segundo blue butterfly occurrence is on Honda Ridge approximately 3.2 miles (5.1 kilometers) south-southeast of SLC-4W (ManTech SRS Technologies Inc. and Arnold 2013).

Recovery of El Segundo Blue Butterfly

The recovery plan for the El Segundo blue butterfly did not contemplate the role of Vandenberg AFB in the species' recovery because the plan was written prior to the observations of this species in Santa Barbara County. Similarly, the 2008 5-year review does not specify the recovery function of Vandenberg AFB for the El Segundo blue butterfly.

The species is considered in the INRMP for Vandenberg AFB (U.S. Air Force 2011) and measures to conserve El Segundo blue butterfly and its host plant are included. The positive conservation measures for El Segundo blue butterfly the Air Force has implemented at the Base so far include: (1) surveys to further delineate the species' occurrence on, and off, the base; (2) removal of invasive plants from potentially suitable habitat; (3) cooperation with research through U.C. Riverside and U.C. Santa Barbara; (4) public outreach; and (5) funding research such as commensal relationships between El Segundo blue butterfly and harvester ants (*Messor* spp., *Pogonomyrmex* spp.). Therefore, although the recovery plan for El Segundo blue butterfly did not consider the potential presence of the species at Vandenberg AFB, nor does the 2008 5-year review specify a recovery function of the base, the Air Force has made a positive effort to conserve the species on Vandenberg AFB, which would be consistent with other recovery efforts.

EFFECTS OF THE ACTION

California Red-legged Frog

If construction activities occur within a period when California red-legged frogs would be dispersing across upland habitats (i.e., during wet weather), individuals could be inadvertently injured or killed by workers or construction equipment during the SLC-4W site improvements. California red-legged frogs dispersing from areas adjacent to the action area are subject to mortality or injury from vehicle strikes and construction activities associated with the proposed project. If construction occurs during the wet season, (typically, from December through March) SpaceX will minimize adverse effects to this species by having a qualified biologist conduct daily pre-construction surveys. The biologist will capture and relocate all California red-legged frogs to the nearest suitable habitat outside of the project area prior to the onset of construction activities. If construction occurs during the wet season, the qualified biologist will also monitor project-related activities to minimize adverse effects on California red-legged frogs and their habitat.

Relocating California red-legged frogs out of harm's way may reduce injury or mortality from equipment, foot traffic, or ground disturbing activities; however, injury or mortality of individuals may occur as a result of improper handling, containment, or transport of individuals or from releasing them into unsuitable habitat (e.g., where exotic predators are present). Observations of diseased and parasite-infected amphibians are frequently reported. This has given rise to concerns that releasing amphibians following a period of captivity, during which time they can pick up infections of disease agents, may cause an increased risk of mortality in wild populations. Amphibian pathogens and parasites can also be carried between habitats on the hands, footwear, or equipment of fieldworkers, which can spread them to localities containing species which have had little or no prior contact with such pathogens or parasites.

Construction noise is not likely to impact California red-legged frogs because of the 1.53 mile (2.5 kilometer) distance between SLC-4W and the nearest occupied California red-legged frog habitat.

Excavation and backfilling associated with the construction of the landing pad and access roads may increase erosion that can lead to sedimentation that could smother California red-legged frogs or reduce the availability of plants and insects that serve as their habitat and food sources. SpaceX will install silt fencing between SLC-4W and Spring Canyon and implement best management practices during project activities to minimize the effects of sedimentation resulting from the proposed project. We anticipate these measures will control and minimize erosion and sedimentation and their effects on California red-legged frogs and habitat.

The populations of California red-legged frog in the recovery unit are considered plentiful and many of those are of high quality. Overall, the effects to the species and its habitat would be relatively minor and temporary. Therefore, we anticipate that the proposed project will not diminish the species' ability to recover.

El Segundo Blue Butterfly

All life stages of the El Segundo blue butterfly associated with their host plant could be affected by the removal of the seacliff buckwheat plants. We assume that when host plants are lost, individual El Segundo blue butterfly larvae could be killed or injured as the plant is damaged or removed. We would expect that adult butterflies, if present, to be able to move out of harm's way to suitable habitat available nearby. Although the seacliff buckwheat plants will be removed by mowing and not disturb the soil beneath the plants, we expect all El Segundo blue butterfly pupae diapausing in the soil could be injured or killed through crushing by the mowing equipment. If El Segundo blue butterfly were present, and diapausing pupae were not injured or killed by mowing equipment, emerging adults would potentially have the opportunity to disperse to nearby seacliff buckwheat plants. Once the 118 seacliff buckwheat plants located within SLC-4W are removed during site improvements, the launch site will be routinely mowed. Any seacliff buckwheat plants that may emerge between mowing events are not expected to grow large enough to provide habitat for El Segundo blue butterfly.

Though the number of seacliff buckwheat plants occurring on Vandenberg AFB has not been estimated, the 0.04 acre (0.016 hectare) area where the 118 individual plants would be removed represents less than one hundredth of a percent of the 1,090 acres (441 hectares) of known occupied El Segundo blue butterfly habitat on base.

SpaceX proposes to enhance seacliff buckwheat habitat at a 2:1 ratio (habitat enhanced: habitat affected) to replace the buckwheat plants removed. While the distribution of seacliff buckwheat, both regionally and on Vandenberg AFB, is greater than the known distribution of El Segundo blue butterfly, in general, the butterfly is negatively affected by its host plants' competition with non-native vegetation. Therefore, the enhancement of seacliff buckwheat plants in an area designated by a biologist familiar with the habitat requirements of the El Segundo blue butterfly should improve and add to the available habitat on Vandenberg AFB.

CUMULATIVE EFFECTS

Cumulative effects include the effects of future State, tribal, local, or private actions that are reasonably certain to occur in the action area considered in this biological opinion. Future Federal actions that are unrelated to the proposed action are not considered in this section because they require consultation pursuant to section 7 of the Act. We are not aware of any non-Federal actions that are reasonably certain to occur in the action area, either on Vandenberg AFB or offshore.

CONCLUSION

In determining whether a proposed action is likely to jeopardize the continued existence of a species, we consider the effects of the action with respect to the reproduction, numbers, and distribution of the species.

After reviewing the current status of the California red-legged frog, the environmental baseline, the effects of the action, and the cumulative effects, it is the Service's biological opinion that the proposed activities will not jeopardize the continued existence of the species. We expect that few, if any, California red-legged frogs occur within the action area and because the measures that SpaceX has proposed should reduce the likelihood of injury or mortality, any reduction in numbers of the species should have an insignificant effect on the species as a whole. Additionally, based on the reproductive biology of the species, the loss of a few individuals is not likely to compromise the conservation of the species because this number represents a very small portion of the total breeding individuals assumed to be present in this region. Further, because the impacts are expected to be temporary in nature and not likely to affect a wide area, we do not expect an overall reduction in the distribution of the species or in the ability of the action area to contribute to the species' recovery. Therefore, we conclude that the project will not reduce appreciably the likelihood of both the survival and recovery of the species in the wild.

The impacts to the El Segundo blue butterfly would be minor because the habitat that would be adversely affected represents only a small fraction of habitat compared with the available habitat on Vandenberg AFB and throughout this species range. Additionally, the buckwheat plants in the action area were within habitat determined to be suitable but unknown to be occupied, so there may be no impacts to the species at all. The Air Force proposes to restore El Segundo blue butterfly habitat by removing invasive plants from suitable habitat areas to create more habitat for the species than would be destroyed. Because a very small amount of El Segundo blue butterfly habitat will be affected, and because the amount of habitat removed will be offset by increasing habitat elsewhere, we do not expect a substantial reduction in numbers, distribution, or reproductive success of the species. Therefore, we conclude that the project will not reduce appreciably the likelihood of both the survival and recovery of the species in the wild.

INCIDENTAL TAKE STATEMENT

Section 9 of the Act and Federal regulation pursuant to section 4(d) of the Act prohibit the take of endangered and threatened wildlife species, respectively, without special exemption. Take is defined as to harass, harm, pursue, hunt, shoot, wound, kill, trap, capture or collect, or to attempt to engage in any such conduct. Harm is further defined by the Service to include significant habitat modification or degradation that results in death or injury to listed wildlife by significantly impairing essential behavioral patterns, including breeding, feeding, or sheltering. Harass is defined by the Service as an intentional or negligent act or omission which creates the likelihood of injury to wildlife by annoying it to such an extent as to significantly disrupt normal behavioral patterns which include, but are not limited to, breeding, feeding or sheltering. Incidental take is defined as take that is incidental to, and not the purpose of, the carrying out of an otherwise lawful activity. Under the terms of section 7(b)(4) and section 7(o)(2), taking that is incidental to and not intended as part of the agency action is not considered to be prohibited taking under the Act provided that such taking is in compliance with the terms and conditions of this incidental take statement.

The measures described below are non-discretionary, and must be undertaken by the Air Force so that they become binding conditions for the exemption in section 7(o)(2) to apply. The Air Force has a continuing duty to regulate the activity covered by this incidental take statement. If the Air Force fails to

assume and implement the terms and conditions, the protective coverage of section 7(o)(2) may lapse. In order to monitor the impact of incidental take, the Air Force must report the progress of the action and its impact on the species to the Service as specified in the incidental take statement. [50 CFR §402.14(i)(3)]

California Red-legged Frog

We anticipate that some California red-legged frogs could be subject to take in the form of injury and mortality by the SLC-4W site improvements. SpaceX proposes to capture and relocate any California red-legged frogs out of harm's way, but some may be missed. We assume the frogs would be capable of moving out of harm's way to some extent, but some may not be detected during surveys and may not be avoided. Lastly, we anticipate that all California red-legged frogs detected will be taken when they are captured and relocated, and that a subset of the individuals captured may be killed or injured due to mishandling or stress.

We cannot quantify the precise numbers of California red-legged frogs that may be captured, killed, or wounded as a result of the actions that SpaceX has proposed because California red-legged frogs move over time; for example, animals may have entered or departed the action area since the time of pre-construction surveys. Other individuals may not be detected due to their cryptic nature, small size, and low mobility. SpaceX has proposed protective measures that are likely to prevent mortality or injury of most individuals. In addition, finding a dead or injured California red-legged frog is unlikely because of their small size and cryptic nature.

Consequently, we are unable to reasonably anticipate the actual number of California red-legged frogs that would be taken by the proposed project; however, we must provide a number at which formal consultation would have to be reinitiated. The Environmental Baseline and Effects Analysis sections of this biological opinion indicate that adverse effects to California red-legged frogs would likely be low given the nature of the proposed activities and the absence of California red-legged frogs found in the action area during previous surveys (ManTech SRS Technologies, Inc. 2013). We therefore anticipate that take of California red-legged frogs would also be low. We also recognize that for every California red-legged frog found dead or injured, other individuals may be killed or injured that are not detected, so when we determine an appropriate take limit we are anticipating that the actual take would be higher and we set the number at a low level.

Similarly, for estimating the number of California red-legged frogs that would be taken by capture, we cannot predict how many may be encountered for reasons stated earlier. Also, the population size fluctuates throughout the year between breeding and non-breading seasons. While the benefits of relocation (i.e., minimizing mortality) outweigh the risk of capture, we must provide a limit for take by capture at which consultation would be reinitiated.

Therefore, if 2 adult, subadult, or juvenile California red-legged frogs are found dead or injured or if 5 are captured and relocated, the Air Force must contact our office immediately to reinitiate formal consultation. Project activities that are likely to cause additional take should cease during this review period because the exemption provided under section 7(o)(2) would lapse and any additional take would not be exempt from the section 9 prohibitions.

El Segundo Blue Butterfly

We anticipate that the El Segundo blue butterfly could be subject to take in the form of harm, injury, and mortality. Removing seacliff buckwheat plants could result in injury or mortality of individual butterflies

because this subspecies spends the vast majority of its life in close association with its host plant. Because of their cryptic nature and because evidence of dead or injured individuals would likely be destroyed by equipment used during the project, detecting dead or injured El Segundo blue butterflies would be extremely difficult. However, if El Segundo blue butterfly are occupying the plants to be removed, the take of El Segundo blue butterflies can be anticipated by destruction of habitat containing seacliff buckwheat. We cannot quantify the precise numbers of El Segundo blue butterfly that may be killed or injured as a result of the actions proposed because the number of individuals associated with any single plant or pupating underground varies. Consequently, we are unable to reasonably anticipate the actual number of El Segundo blue butterflies that would be taken by the proposed project; however, we must provide a number at which formal consultation would have to be reinitiated. The use of seacliff buckwheat plants as a surrogate for the take of individual butterflies is appropriate because reliance on finding injured or dead individuals would likely underestimate the actual effects of the action; i.e., the number of individual butterflies found dead or injured is going to be lower than what actually occurs. By using the habitat to determine the level of take we anticipate, we have a measurable accurate estimation of the actual impact. Therefore, if more than 118 seacliff buckwheat plants are removed during SLC-4W site improvements, the Air Force must reinitiate formal consultation with the Service.

REASONABLE AND PRUDENT MEASURES

The Service's evaluation of the effects of the proposed action includes consideration of the measures developed by the Air Force, and repeated in the Description of the Proposed Action portion of this biological opinion, to minimize the adverse effects of the proposed action on the California red-legged frog and El Segundo blue butterfly. The Service believes these measures are adequate and appropriate to minimize the impacts of the incidental take of California red-legged frog and El Segundo blue butterfly. Therefore, we are not including any reasonable and prudent measures and terms and conditions in this incidental take statement. Any subsequent changes in the minimization measures proposed by the Air Force may constitute a modification of the proposed action and may warrant reinitiation of formal consultation, as specified at 50 CFR 402.16.

REPORTING REQUIREMENTS

The Air Force must provide a written report to the Service within 90 days following completion of the proposed project. The report must state the impacts to habitat for the El Segundo blue butterfly (i.e., loss of host plants/suitable habitat), and the number of El Segundo blue butterflies and California red-legged frogs killed or injured, describing the circumstances of the mortalities or injuries if known. The report must also document the number and size of any California red-legged frogs relocated from the action area, the date and time of relocation, and a description of relocation sites. The report must contain a brief discussion of any problems encountered in implementing minimization measures, results of biological surveys and sighting records, and any other pertinent information. We encourage you to submit recommendations regarding modification of or additional measures that would improve or maintain protection of the California red-legged frog or the El Segundo blue butterfly, while simplifying compliance with the Act.

DISPOSITION OF DEAD OR INJURED SPECIMENS

Within 3 working days of locating a dead or injured California red-legged frog or El Segundo blue butterfly, the Air Force must make initial notification by telephone and writing to the Ventura Fish and Wildlife Office in Ventura, California, (2493 Portola Road, Suite B, Ventura, California 93003, (805)

644-1766). The report must include the time and date, location of the carcass, a photograph, cause of death if known, and any other pertinent information.

Care must be taken in handling dead specimens to preserve biological material in the best possible state for later analysis. If any injured California red-legged frogs survive, the Air Force should contact us regarding their final disposition.

Any remains of dead California red-legged frog or El Segundo blue butterfly must be placed with educational or research institutions holding the appropriate State and Federal permits, such as the Santa Barbara Natural History Museum (Contact: Paul Collins, Santa Barbara Natural History Museum, Vertebrate Zoology Department, 2559 Puesta Del Sol, Santa Barbara, California 93460, (805) 682-4711, extension 321).

REINITIATION NOTICE

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

If you have any questions, please contact Bill Standley of our staff at (805) 644-1766, extension 315.

Sincerely,

Stephen P. Henry
Field Supervisor

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DEPARTMENT OF THE AIR FORCE
30TH SPACE WING (AFSPC)

APR 15 2015

Beatrice L. Kephart
30 CES/CEI
1028 Iceland Ave
Vandenberg AFB CA 93437-6010

Mr. Stephen P. Henry
U.S. Fish and Wildlife Service
Ventura Fish and Wildlife Office
2493 Portola Road, Suite B
Ventura CA 93003

Dear Mr. Henry

Per Section 7 of the Endangered Species Act of 1973 (as amended), I am requesting your concurrence that planned Falcon 9 boostback and landing actions at Space Launch Complex 4 West (SLC-4W) "may affect, but are not likely to adversely affect" (NLAA) the California red-legged frog (*Rana draytonii,* CRLF), California least tern (*Sternula antillarum browni*), the Western snowy plover (*Charadrius nivosus*) or the Southern sea otter (*Enhydra lutris nereis*). No listed plant species will be impacted. Biological Opinion for In-Flight Abort Test and Improvements to SLC-4W, (8-8-14-F-41) separately considered impacts to CRLF and El Segundo blue butterfly (*Euphilotes battoides near allyni*).

SpaceX currently operates the Falcon 9 Launch Program at SLC 4-E and proposes to accomplish recovery and re-use of the first stage of future Falcon launch vehicles (up to 10 per year). Boost-back and recovery will require up to three engines for controlled descent to SLC4-W shortly after launch from SLC 4-E. We expect mild to moderate sonic booms upon booster re-entry. Noise from the "retrograde burn" and first stage descent will potentially impact SLC-4W and the surrounding area, although landing-related noise will be much less than launch noise. Extensive discussions with your staff (Mr. Phillips, Mr. Standley and Ms. Carswell) and their review of a draft Biological Assessment, including detailed information about sonic boom paramenters and sea otter hearing sensitivity, resulted in a NLAA determination. We are formally including that draft Biological Assessment for your review.

Please contact me at (805) 605-7924 or Darryl York at (805) 605-8684 with any questions.

Sincerely

BEATRICE L. KEPHART
Chief, Installation Management Flight

Attachment:
Draft Biological Assessment

Biological Assessment for Boost-Back Landing of the Falcon 9 First Stage at SLC-4 West, Vandenberg Air Force Base, California

2 April 2015

Prepared for:

Space Exploration Technologies Corporation
1 Rocket Road
Hawthorne, CA 92050

and

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

Prepared by:

ManTech SRS Technologies, Inc.
102 East Ocean Ave.
Lompoc, CA 93436

Table of Contents

1.0 Background 1

2.0 Project Description 4
- 2.1 Proposed Action – Boost-Back 4
- 2.2 Minimization and Monitoring Measures 7
  - 2.2.1 California Red-legged Frog 7
  - 2.2.2 California Least Tern 7
  - 2.2.3 Western Snowy Plover 7
  - 2.2.4 Southern Sea Otter 8

3.0 Methods 9

4.0 Results 9
- 4.1 Other Federally Listed Species Considered 9
- 4.2 California Red-legged Frog [Federally Threatened Species] 11
  - 4.2.1 Status 11
  - 4.2.2 Life History 11
  - 4.2.3 Occurrence within the Proposed Action Area 11
- 4.3 California Least Tern [Federally Endangered Species] 14
  - 4.3.1 Status 14
  - 4.3.2 Life History 14
  - 4.3.3 Occurrence within the Proposed Action Area 14
- 4.4 Western Snowy Plover [Federally Threatened Species] 16
  - 4.4.1 Status 16
  - 4.4.2 Life History 16
  - 4.4.3 Occurrence within the Proposed Action Area 16
- 4.5 Southern Sea Otter [Federally Threatened Species] 16
  - 4.5.1 Status 16
  - 4.5.2 Life History 16
  - 4.5.3 Occurrence within the Proposed Action Area 17
- 4.6 Vegetation Types 19

5.0 Effects of the Proposed Action 19
- 5.1 California Red-legged Frog 19
- 5.2 California Least Tern 20
- 5.3 Western Snowy Plover 21
- 5.4 Southern Sea Otter 22

6.0 Interrelated and Interdependent Actions 24

7.0 Cumulative Impacts 24

8.0 ESA Determination Conclusions 25

9.0 List of Preparers 26

10.0 Bibliography 27

Figures

Figure 1-1. Regional location of Action Area 2
Figure 2-1. Stages of Boost-back and Propulsive Landing 5
Figure 2-2. Boost-back engine landing noise contours generated by a sample trajectory 6
Figure 4-1. CRLF localities on VAFB and sonic boom intensity 13
Figure 4-2. LETE and WSPL nesting localities and sonic boom intensity 15
Figure 4-3. Southern sea otter distribution and sonic boom intensity 18
Figure 5-1. Sonic boom spectrum and sea otter hearing sensitivity curve 24

Tables

Table 8-1. Endangered Species Act Determinations of Effects of the Boost-Back Landing 25

Acronyms and Abbreviations

30 CES/CEIEA	30th Space Wing, Installation Management Flight, Environmental Conservation
Base	Vandenberg Air Force Base
BO	Biological Opinion
CRLF	California red-legged frog
dB	Decibel(s)
dBA	Decibel(s), A-Weighted
E	East
ESA	Endangered Species Act
FSDP	Flight Safety Data Plan
FR	Federal Register
km	kilometer
km^2	square kilometers
LBVI	least Bell's vireo
LETE	California least tern
LOX	liquid oxygen
MSRS	ManTech SRS Technologies, Inc.
psf	pound per square foot
RP	rocket propellant
SEL	Sound Exposure Level
SLC	space launch complex
SNPL	western snowy plover
SpaceX	Space Exploration Technologies Corporation
spp	species
SRS	SRS Technologies, Inc.
SWFL	southwestern willow flycatcher
TWG	tidewater goby
U.S.	United States
USAF	United States Air Force
USFWS	United States Fish and Wildlife Service
USGS	U.S. Geological Survey
UTS	unarmored threespine stickleback
VAFB	Vandenberg Air Force Base
W	West
YBCU	yellow-billed cuckoo

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1.0 Background

Vandenberg Air Force Base (VAFB or Base) occupies approximately 99,100 acres (400 square kilometers [km^2]) of central Santa Barbara County, California (Figure 1-1). The 30th Space Wing at VAFB is the Air Force Space Command organization responsible for Department of Defense space and missile launch activities on the west coast of the United States (U.S.). Satellites destined for polar or near-polar orbit are launched from VAFB, and ballistic missiles are tested. The wing supports West Coast launch activities for the U.S. Air Force (USAF), Department of Defense, Missile Defense Agency, National Aeronautics and Space Administration, foreign nations, and various private industry contractors.

This biological assessment examines the potential effects of a Proposed Action on federally listed species as required by section 7 of the Endangered Species Act (ESA): California red-legged frog [*Rana draytonii* (CRLF)], western snowy plover [*Charadrius nivosus* (SNPL)], California least tern [*Sterna antillarum browni* (LETE)] and southern sea otter [*Enhydra lutris nereis*].

Space Launch Complex 4 (SLC-4) was originally constructed to launch Atlas/Agena missiles for the Point Arguello Naval Station. In 1966, the USAF assumed responsibility for the complex and continued to launch Atlas/Agena vehicles until 1971. In 1971, SLC-4 East (E) began service as a component of the Titan launch program. A total of 65 vehicles have been launched from SLC-4E to date. The site was decommissioned in the summer of 2005 following the final Titan launch.

Pursuant to section 7 of the ESA, consultation with U.S. Fish and Wildlife Service (USFWS) for the Titan space launch vehicle program was completed in 1988 (U.S. Fish and Wildlife Service 1988), and again in 1996 (U.S. Fish and Wildlife Service 1996). The USFWS determined that activities associated with the Titan program were not likely to jeopardize the continued existence of beach layia (*Layia carnosa*), unarmored threespine stickleback (*Gasterosteus aculeatus williamsoni*), tidewater goby (*Eucyclogobius newberryi*), California red-legged frog, California brown pelican (*Pelecanus occidentalis californicus*), American peregrine falcon (*Falco peregrinus anatum*), least Bell's vireo (*Vireo bellii pusillus*), southwestern willow flycatcher (*Empidonax traillii extimus*), bald eagle (*Haliaeetus leucocephalus*), western snowy plover, and southern sea otter.

Subsequent to these consultations, California brown pelican, American peregrine falcon, and bald eagle have been delisted. Tidewater goby is proposed for downlisting from Endangered to Threatened. Despite surveys conducted in potential habitat, least Bell's vireo has not been documented on VAFB. Gaviota tarplant (*Deinandra increscens* ssp. *villosa*), El Segundo blue butterfly (*Euphilotes battoides allyni*), and yellow-billed cuckoo (*Coccyzus americanus*) were not included in these consultations. Gaviota tarplant was listed as federally endangered in 2000 (65 Federal Register [FR] 14888–14898). A *Euphilotes* species documented on VAFB in 2004 was determined to be the El Segundo blue butterfly (*Euphilotes battoides allyni*) in 2006, which was listed as federally endangered in 1976 (41 FR 22041). Yellow-billed cuckoo was listed as federally threatened in 2014 (79 FR 59992–60038).

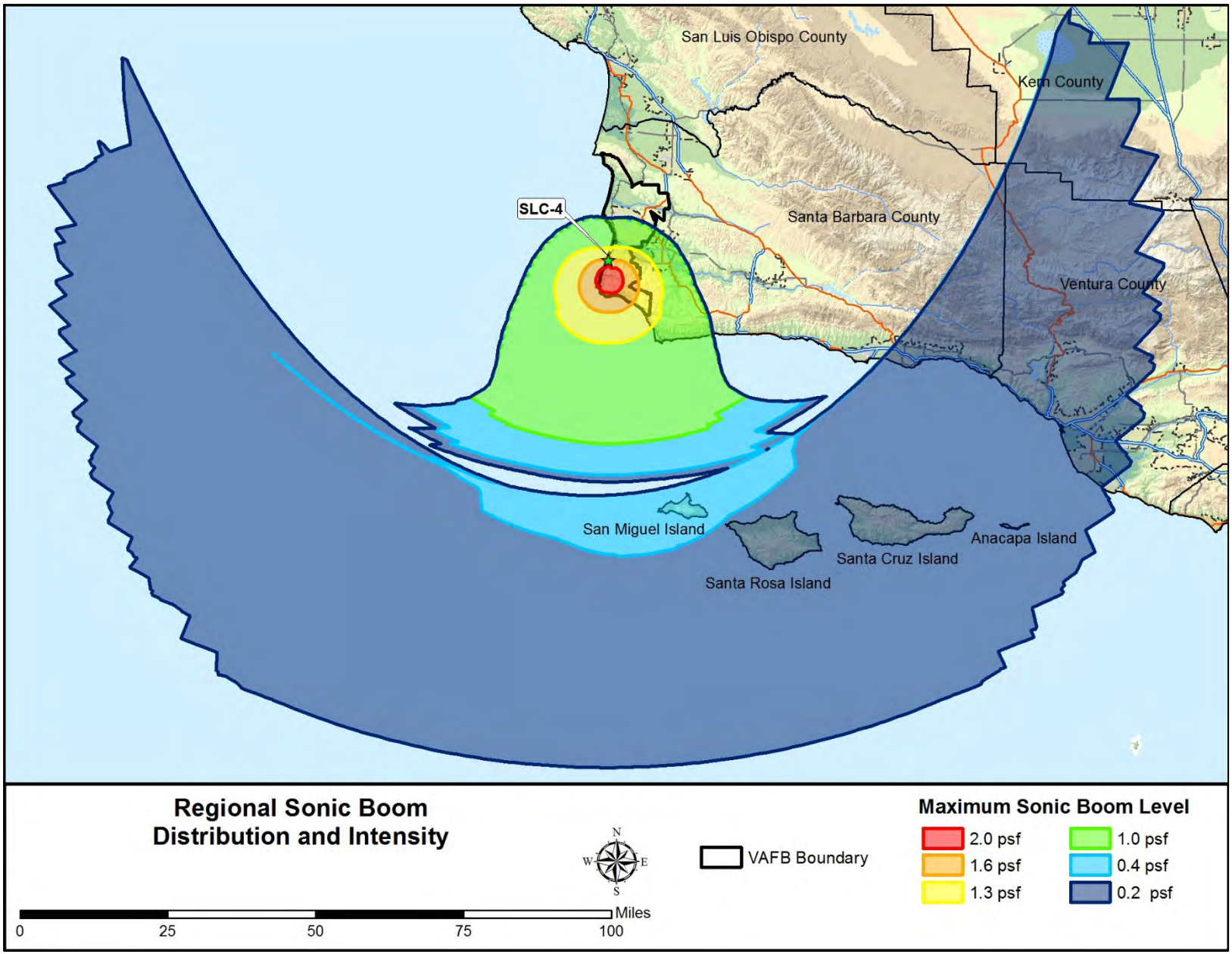


Figure 1-1. Regional location of Action Area

Section 7 consultation with USFWS also occurred for activities associated with the maintenance of the basewide network of firebreaks and fire access roads (U.S. Fish and Wildlife Service 2006). The resultant Biological Opinion (BO) encompassed the network of firebreaks and fire access roads in place around the exterior of SLC-4, but has now been superseded by the Programmatic Biological Opinion (U.S. Fish and Wildlife Service 2011b).

Space Exploration Technologies Corporation (SpaceX) is currently operating the Falcon Launch Vehicle Program at SLC-4. A section 7 consultation with the USFWS focusing on the modification and use of SLC-4 to support the Falcon 9 and Falcon 9 Heavy Programs was completed in 2011 (U.S. Fish and Wildlife Service 2011a). A second section 7 consultation was initiated in 2014 to include an operational check, abort test, a one-time boost-back and landing, and infrastructure improvements at SLC-4 West (W), which were not anticipated at the time the initial consultations relating to the Falcon Vehicle Program were conducted (Tetra Tech 2014). The boost-back landing analyzed in the 2014 consultation also followed an east-west trajectory, as opposed to a north-south trajectory, which led to a different distribution of projected noise and related impacts (Tetra Tech 2014) than those assessed herein.

The Proposed Action consists of regular employment of stage recovery (boost-back and landing) which is expected to be a standard component of future launches. SpaceX anticipates a maximum of 10 launches from SLC-4E during any given year. Under the Proposed Action the Falcon 9 first stage would return to VAFB for potential reuse following each launch.

2.0 Project Description

2.1 Proposed Action – Boost-Back

SpaceX proposes to return the Falcon 9 first stage to SLC-4W at VAFB for potential reuse. The Falcon 9 first stage is 12 feet in diameter and 160 feet in height, including the interstage that would be attached during landing. After the first stage engine cutoff, exoatmospheric cold gas thrusters would be triggered to flip the first stage into position for retrograde burn. Three of the nine first stage Merlin engines would be restarted to conduct the retrograde burn in order to reduce the velocity of the first stage and to place the first stage in the correct angle to land. Once the first stage is in position and approaching its landing target, the three engines would be cut off to end the boost-back burn. The first stage would then perform a controlled descent using atmospheric resistance to slow the stage down and guide it to the landing pad target. The first stage is outfitted with grid fins that allow cross range corrections as needed. The landing legs on the first stage would then deploy in preparation for a final single engine burn that would slow the first stage to a velocity of zero before landing on the landing pad at SLC-4W. Figure 2-1 provides a graphical depiction of the boost-back and landing sequence. The detailed sequence of events for first stage landing along with trajectory data would be provided in the Flight Safety Data Plan (FSDP) once it is finalized.

During descent, a sonic boom (overpressure of high energy impulsive sound) would be generated while the first-stage booster is supersonic. The overpressure would be directed at the coastal area south of SLC-4 (Figure 1-1) and would reach as high as 2.0 pounds per square foot (psf). Engine noise would also be produced during the landing of the Falcon 9 first stage (Figure 2-2), but it would be less than the noise generated during the launch.

Although propellants would be burned to depletion during flight, there is a potential for approximately eight gallons of Liquid Oxygen (LOX) and a maximum of 67.5 gallons of Rocket Propellant (RP-1) to remain in the Falcon 9 first stage upon landing. Final volumes of fuel remaining in the first stage upon landing may vary and would be included in the FSDP. Once the first stage has landed and been secured, any remaining LOX and RP-1 would be properly off-loaded and disposed or re-used.

The frequency of boost-back and landings of the Falcon 9 first stage would be up to 10 per year.

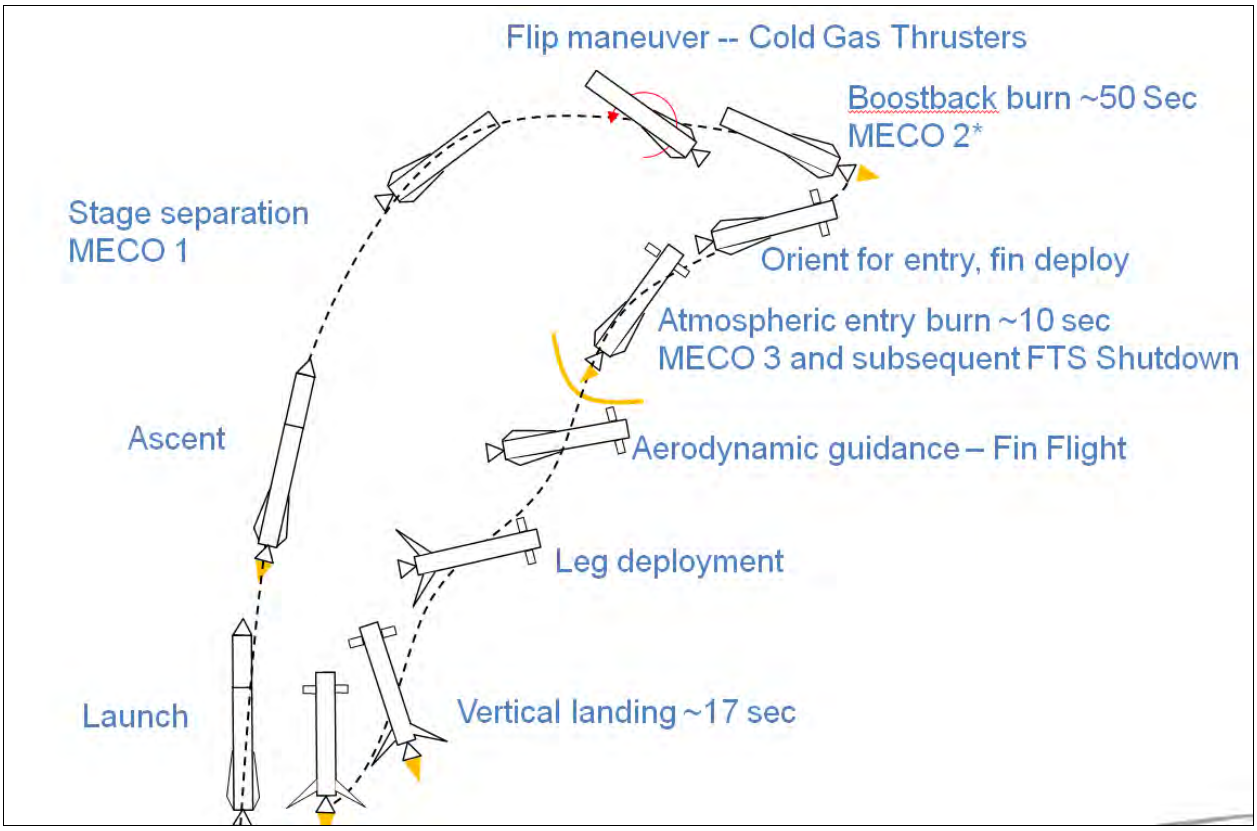


Figure 2-1. Stages of boost-back and propulsive landing

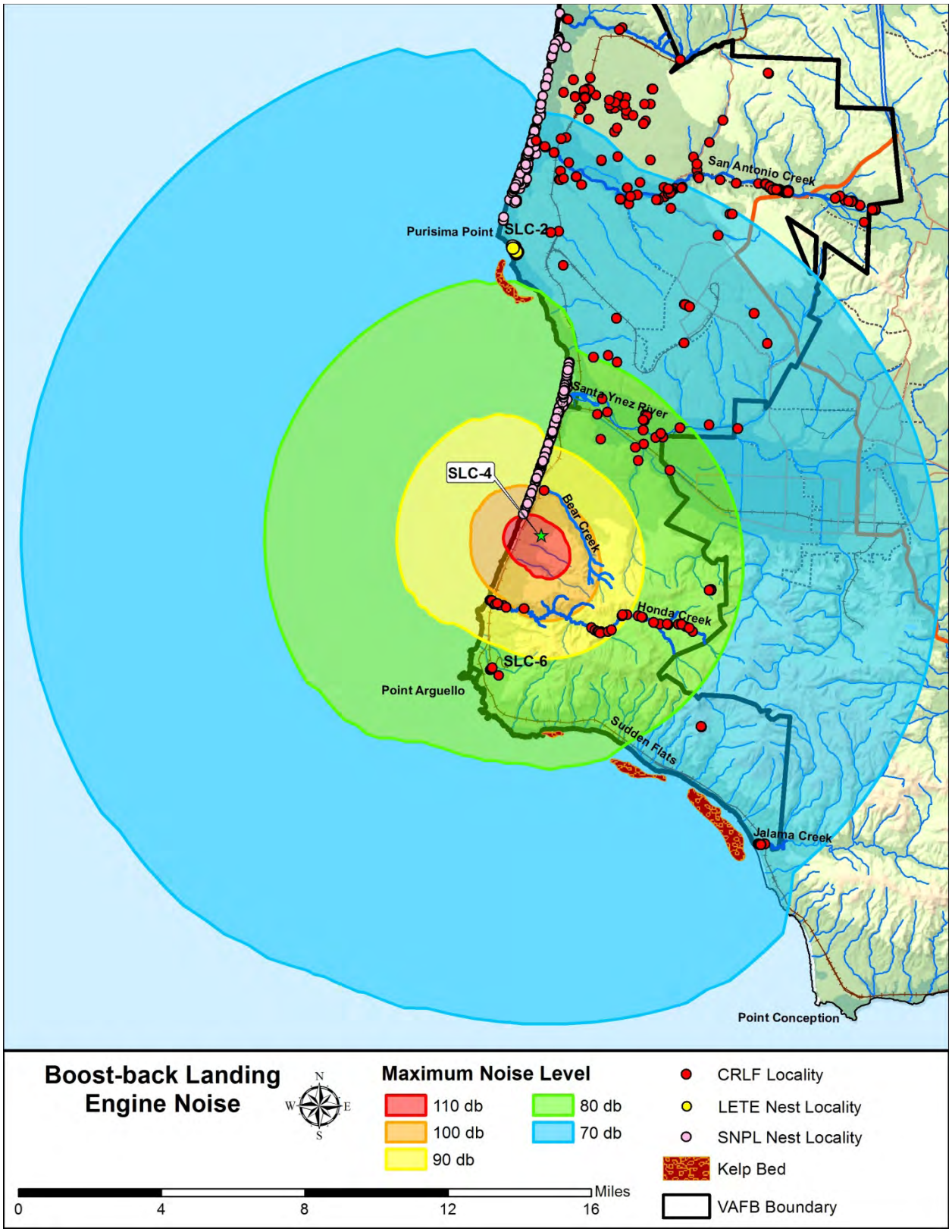


Figure 2-2. Boost-back engine landing noise contours generated by a sample trajectory

2.2 Minimization and Monitoring Measures

The minimization and monitoring measures listed below for California LETE, western SNPL, and southern sea otter would be implemented to avoid, minimize, and/or characterize the effects of planned project activities.

2.2.1 California Red-legged Frog

There are no minimization or monitoring measures proposed for CRLF.

2.2.2 California Least Tern

- Monitoring of breeding LETE at the Purisima Point nesting colony would be conducted, at a minimum, during the initial three boost-back and landing events that occur when LETE are present (15 April to 15 September), when a sonic boom of 1 psf or greater is predicted to impact LETE nesting habitat in order to characterize any potential impacts from the Proposed Action on LETE. If adverse effects are documented or the results of monitoring are inconclusive, monitoring would continue for subsequent boost-back landings until the nature of effects can be accurately determined.
    - A USFWS-approved biologist would conduct daily counts of LETE at the Purisima Point nesting colony beginning 3 days before the boost-back and landing event through 3 days after. These data would be used to determine whether the Proposed Action had an effect on habitat use patterns within the impact area or caused any mortality, injury, or abnormal behavior.
    - If there are no safety zone closures, LETE at the Purisima Point nesting colony would be visually monitored during boost-back landing for daytime launches. Monitoring would be conducted by a USFWS-approved biologist.
    - Acoustic recording equipment would be deployed at or near the monitoring location to document and quantify noise impacts.

2.2.3 Western Snowy Plover

- Between 1 March and 30 September, monitoring of nesting SNPL would be conducted during boost-back and landing events to characterize potential impacts on SNPL reproductive success. At a minimum, monitoring would be conducted during the initial three boost-back and landing events during SNPL nesting season when a sonic boom of 1 psf or greater is predicted to impact SNPL breeding habitat. If adverse effects are documented or the results of monitoring are inconclusive, monitoring would continue for subsequent boost-back landings until the nature of effects can be accurately determined.
    - Sonic boom modeling would be conducted prior to the boost-back and landing to determine the intensity, most likely impact locations, and whether SNPL breeding habitat would potentially be impacted by a sonic boom greater than 1 psf.

- If a sonic boom of 1 psf or greater is expected to impact SNPL breeding habitat during SNPL nesting season, a USFWS-approved biologist would monitor SNPL populations within the predicted impact area. Daily counts and nest monitoring would begin 3 days prior to the boost back and landing event and continue through 3 days after. These data would be used to determine whether the Proposed Action had an effect on habitat use patterns, population size within the impact area, nesting success, or caused any mortality, injury, or abnormal behavior.
- If there are no safety zone closures, active SNPL nests nearest to the peak sonic boom impact area would be monitored during boost-back landing during daytime launches. Monitoring would be conducted by a USFWS-approved biologist or via video depending feasibility and access constraints.
- Acoustic recording equipment would be deployed at or near the monitoring location to document and quantify noise impacts.

2.2.4 Southern Sea Otter

- A USFWS-approved biologist would monitor southern sea otters whenever a sonic boom of 1 psf or greater is predicted to be generated by the boost-back that would impact southern sea otter habitat. At a minimum, monitoring would be conducted during the initial three boost-back and landing events when a sonic boom of 1 psf or greater is predicted to impact sea otter habitat. If adverse effects are documented or the results of monitoring are inconclusive, monitoring would continue for subsequent boost-back and landings until the nature of effects can be accurately determined. Monitoring would be conducted by a USFWS-approved biologist or via video depending on feasibility and access constraints.
  - Sonic boom modeling would be conducted prior to the boost-back landing to determine the intensity and most likely impact locations.
  - The monitoring locations would be selected based on where pressure waves greater than 1 psf are predicted to impact and the relation of these locations to sea otter habitat. The monitoring locations are generally expected to be on Sudden Flats on South VAFB.
  - A USFWS-approved biologist would conduct daily counts of sea otters at each of the selected monitoring locations beginning 3 days before and continuing 3 days after the boost-back and landing. The monitor would note any mortality, injury, or abnormal behavior observed during these counts. Weather permitting, the counts would be conducted between 09:00 and 12:00, when otters are most likely to be rafting (Estes et al. 1986). This would maintain daily consistency in detectability. Monitors would use both binoculars (10X) and a high-resolution 50–80X telescope to conduct counts.
  - Acoustic recording equipment would be deployed at or near the monitoring locations to document and quantify noise impacts.

3.0 Methods

Impacts to listed species were considered for all areas potentially impacted by visual disturbance, landing noise, and sonic boom. Prior special status species monitoring data, surveys, and California Natural Diversity Database records were consulted to assess the potential occurrence, distribution, and habitat use of listed species within the Action Area.

4.0 Results

4.1 Other Federally Listed Species Considered

Effects on the following federally listed species were considered, but discounted for the reasons described below:

- **Gaviota tarplant [Federally Endangered Species]:** Any ground-disturbing impacts associated with boost-back and landing of the Falcon 9 first stage are expected to be confined to the area of the landing pad. As such, there would be no impacts to special status plant species documented on south VAFB, including Gaviota tarplant.
- **Beach layia [Federally Endangered Species]:** Any ground-disturbing impacts associated with boost-back and landing of the Falcon 9 first stage are expected to be confined to the area of the landing pad. As such, there would be no impacts to special status plant species documented on south VAFB, including beach layia.
- **El Segundo blue butterfly [Federally Endangered Species]:** Any ground disturbing impacts associated with boost-back and landing of the Falcon 9 first stage are expected to be confined to the area of the landing pad. As such, there would be no impacts to special status plant species documented on south VAFB, including the El Segundo blue butterfly's host plant, seacliff buckwheat (*Eriogonum parvifolium*).
- **Tidewater goby [Federally Endangered Species]:** All currently occupied tidewater goby (TWG) habitat is outside of the overflight zone, and water would be expected to attenuate any potential noise impacts (Godin 2008). Within the overflight zone, Cañada Honda Creek was formerly occupied by this species. Cañada Honda Creek is located approximately 2.6 miles southwest of SLC-4E. When they occurred at this location, the TWG were confined to the lagoon within Cañada Honda Creek (Swift et al. 1997). TWG were not present at this site in 2008 (ManTech SRS Technologies, Inc. 2009b), and the lagoon dried completely as a result of persistent drought conditions in the summer of 2014. The nearest known currently occupied habitat is the Santa Ynez River, 3.5 miles north of the project site. Even if TWG were to re-colonize Cañada Honda Creek, water would be expected to attenuate any potential noise (Godin 2008) occurring as a result of the Proposed Action. Therefore, there would be no effect on TWG as a result of the Proposed Action.
- **Unarmored threespine stickleback [Federally Endangered Species]:** All occupied habitat for unarmored threespine stickleback (UTS) is outside of the overflight zone, and water would be expected to attenuate any potential noise impacts (Godin 2008). Within the overflight zone, Cañada Honda Creek was formerly occupied by this species.

Reintroduction of UTS into Cañada Honda Creek was attempted through a joint effort between the USFWS and VAFB in 1984, during which UTS from the Barka Slough section of San Antonio Creek were introduced into the middle and upper sections of Cañada Honda Creek. The population survived the initial introduction and was able to reproduce (Swift 2009). However, intensive surveys conducted by ManTech SRS Technologies, Inc. (MSRS) in 2008 failed to find UTS, or any other fish, in Cañada Honda Creek (ManTech SRS Technologies, Inc. 2009b). This indicated that the re-introduction was unsuccessful and the Cañada Honda population did not persist. UTS occupancy on VAFB is therefore limited to San Antonio Creek. Thus, there would be no effect on UTS as a result of the Proposed Action.

- **Southwestern willow flycatcher [Federally Endangered Species]**: Between 1995 and 2004, a small population of southwestern willow flycatcher (SWFL), up to five adults, occurred on VAFB. This population was distributed between two sites: one in willow riparian habitat on the north bank of the Santa Ynez River, west of 13th Street; and the second at the waterfowl natural resources area, also on the north bank of the Santa Ynez River. There have been no confirmed sightings or observed breeding activity of SWFL at VAFB since 2004 (SRS Technologies, Inc. 2004; Ball et al. 2012). This indicates that VAFB likely no longer supports this species. Therefore, there would be no effect on SWFL as a result of the Proposed Action.
- **Least Bell's vireo [Federally Endangered Species]:** There are no breeding records for least Bell's vireo (LBVI) on VAFB and only two documented records of occurrence. Both records were east of the 13th Street Bridge over the Santa Ynez River, and are more than 10 years old (Holmgren & Collins 1999). In addition, regular riparian point count surveys along the Santa Ynez River over the past 10 years have not documented this species (Seavy et al. 2012); therefore, this species is unlikely to occur on VAFB and there would be no effect on LBVI as a result of the Proposed Action.
- **Yellow-billed Cuckoo [Federally Threatened Species]:** There are 18 documented yellow-billed cuckoo (YBCU) sightings recorded for Santa Barbara County, dating back to the early 1960s. These include two observations of migrating birds on VAFB. One observation occurred in 1982 at Barka Slough and the second in 2002 at Cañada Honda Creek. No records of YBCU breeding exist for Santa Barbara County (Lehman 1994, revised draft 2014). The Cañada Honda Creek observation represents a transitory individual observed more than 12 years ago (Lehman 1994, revised draft 2014). This indicates that VAFB does not regularly support this species. In addition, Cañada Honda Creek consists of marginal YBCU habitat and is not suitable for YBCU breeding. Therefore, there would be no effect on YBCU as a result of the Proposed Action.

4.2 California Red-legged Frog [Federally Threatened Species]

4.2.1 Status

CRLF were listed as federally threatened by the USFWS on 23 May 1996 (61 FR 25813-25833). In 2002, the USFWS issued a Recovery Plan to stabilize and restore CRLF populations (U.S. Fish and Wildlife Service 2002). Critical habitat was designated on 17 March 2010 (50 FR 12816-12959); however, the designation does not include VAFB, since it was excluded under section 4(b)(2) of the ESA, for reasons including impacts on national security.

4.2.2 Life History

The CRLF is a member of the family Ranidae and is California's largest native frog. In order to breed, CRLF require water bodies with sufficient hydroperiods and compatible salinity levels to accommodate larval and egg development. Breeding typically takes place from November through April with most egg deposition occurring in March. Eggs require 6–14 days, depending on water temperature, to develop into tadpoles (Jennings 1988). Tadpoles typically require 11–20 weeks to develop into terrestrial frogs (U.S. Fish and Wildlife Service 2002), although some individuals may overwinter in the tadpole stage (Fellers et al. 2001).

Adult CRLF have been documented traveling distances of up to 2 miles during the wet season and spend considerable time in terrestrial riparian vegetation (Bulger et al. 2003). It is thought that riparian vegetation provides good foraging habitat, as well as good dispersal corridors, due to canopy cover and presence of moisture (U.S. Fish and Wildlife Service 2002).

Habitat loss and degradation as a result of stream alteration, ground water depletion, loss of wetland, and expanding urbanization were, and continue to be, important factors in the decline of CRLF from the early-to-mid-1900s to present (Jennings and Hayes 1994). Diseases and competition and predation from non-native species, including the bullfrog (*Lithobates catesbeiana*), catfish (*Ictalurus* spp.), bass (*Micropterus* spp.), mosquitofish (*Gambusia affinis*), and exotic crayfish (e.g., *Procambarus clarkia*), have also had significant impacts on CRLF populations (Jennings and Hayes 1994).

4.2.3 Occurrence within the Proposed Action Area

Regular CRLF surveys have occurred across VAFB since the early 1990s (Christopher 1996, 2004; ManTech SRS Technologies 2009a) and have shown that CRLF can potentially occur in virtually all known wetlands and bodies of water on VAFB. During the boost-back and landing of the Falcon 9 first stage, a sonic boom of 1–2 psf is expected to impact CRLF populations from Purisima Point south to Jalama Creek, including the Santa Ynez River and all of south VAFB (Figure 4-1). During landing, engine noise of approximately 70 decibels (dB) is expected to impact CRLF populations from San Antonio Creek to Jalama Creek (Figure 2-2). However, only CRLF in Bear Creek, Cañada Honda Creek, the vicinity of SLC-6, and, potentially, Spring Canyon, would be expected to experience landing noise over 100 dB (Figure 2-2).

The Santa Ynez River and Bear Creek, to the north of SLC-4, have CRLF populations and suitable breeding habitat (Christopher 1996, 2004; SRS Technologies, Inc. 2001; ManTech SRS

Technologies, Inc. 2009a). Spring Canyon is an ephemeral drainage located approximately 200 feet south of SLC-4 that has potentially suitable habitat for CRLF in high rain years (ManTech SRS Technologies, Inc. 2013). South of SLC-4, suitable CRLF populations and breeding habitat are found in Cañada Honda Creek and Jalama Creek, along with scattered CRLF localities in minor wetlands and drainages across south VAFB (Christopher 1996, 2004; ManTech SRS Technologies, inc. 2009a). CRLF populations at Cañada Honda Creek and potentially at Spring Canyon would be within the overflight zone.

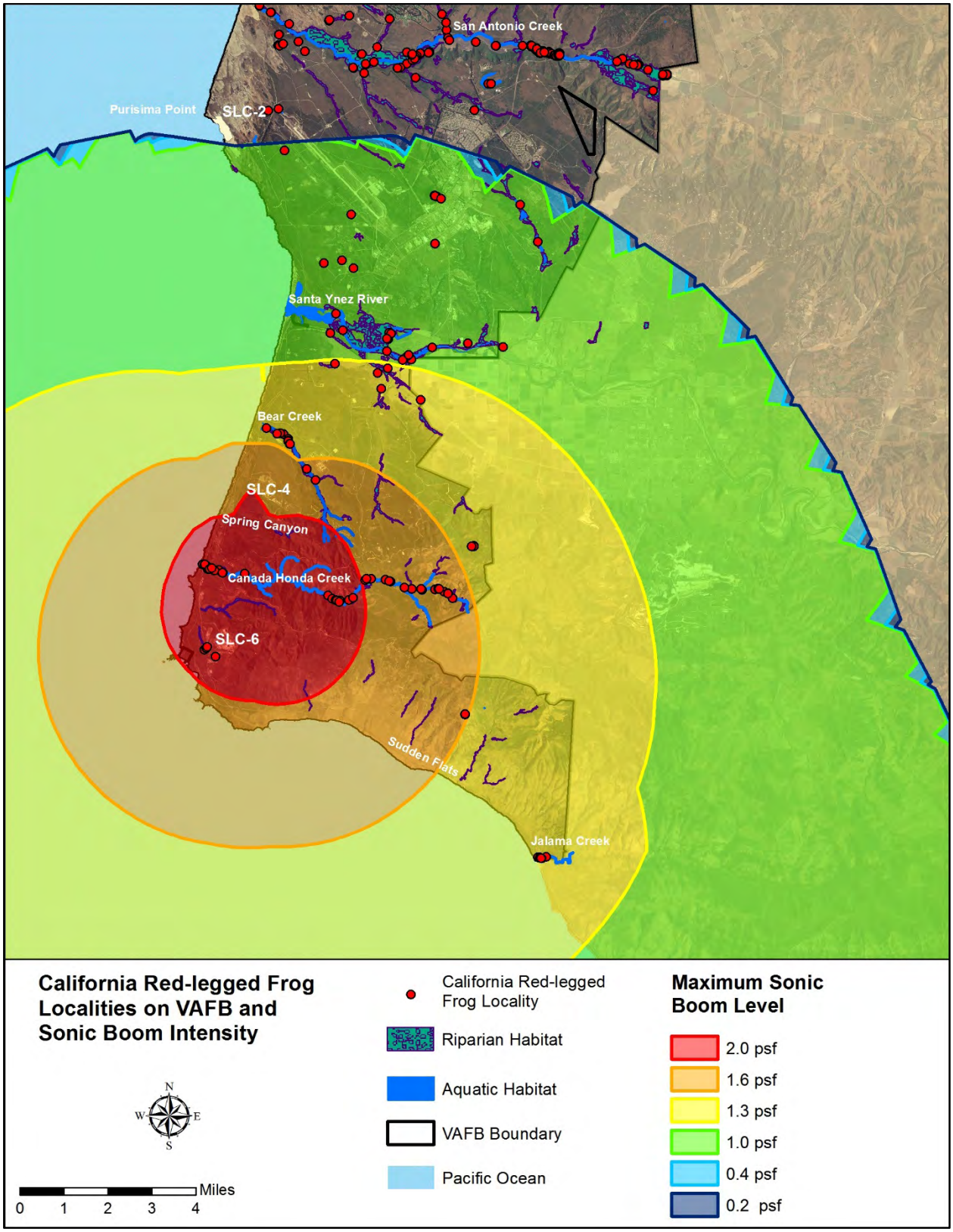


Figure 4-1. CRLF localities on VAFB and sonic boom intensity

4.3 California Least Tern [Federally Endangered Species]

4.3.1 Status

The USFWS listed the LETE as federally endangered on 13 October 1970 (35 FR 16047-16048). Critical habitat for this species has not been designated. As a result, the Proposed Action would not affect critical habitat for the LETE.

4.3.2 Life History

The LETE is the smallest of the North American terns and is found along the Pacific Coast of California, from San Francisco southward to Baja California. It has a distinctive black cap with stripes running across the eyes to the beak. The upperparts are gray and the underparts are white.

The California populations are localized and increasingly fragmented, due to coastal development resulting in habitat loss. LETE are migratory and winter along the Pacific coast of southern Mexico and the Gulf of California. They usually arrive at breeding grounds by the last week of April and return to wintering grounds in August. This species nests in colonies on relatively open beaches kept free of vegetation by natural scouring from tidal or wind action.

Historically, LETE nested in colonies in several locations along the coastal strand of the north VAFB coastline. Since 1998, with the exception of two nests established south of San Antonio Creek in 2002, LETE have nested only at the primary colony site, in relatively undisturbed bluff-top open dune habitat at Purisima Point.

4.3.3 Occurrence within the Proposed Action Area

On VAFB, a LETE breeding colony is found at Purisima Point and LETE forage in the lagoons formed at the mouths of the Santa Ynez River and San Antonio Creek (Figure 4-2), and at other near-shore locations at VAFB. VAFB supports a very small percentage of California's breeding population of LETE. However, as one of only three known breeding colonies between Monterey and Point Conception, the population on VAFB remains significant.

LETE foraging and breeding areas are not within the overflight zone of the Proposed Action. The nearest LETE nesting colony at Purisima Point is located approximately 8 miles north (Figure 4-2). The breeding colony is within an area expected to receive landing engine noise within 70–80 dB (Figure 1-1), and a sonic boom up to 0.2 psf (Figure 4-2). Adult LETE forage in the Santa Ynez River lagoon and estuary (Figure 4-2). After young have fledged in late summer, LETE will also disperse to this location to forage in the lagoon and roost on adjacent sandbars before migrating south for the winter (Robinette and Howar 2010). The Santa Ynez River lagoon is approximately 3.7 miles north of SLC-4W, expected to receive landing engine noise within 80–90 dB (Figure 2-2), and within the area expected to receive a sonic boom up to 1 psf (Figure 4-2).

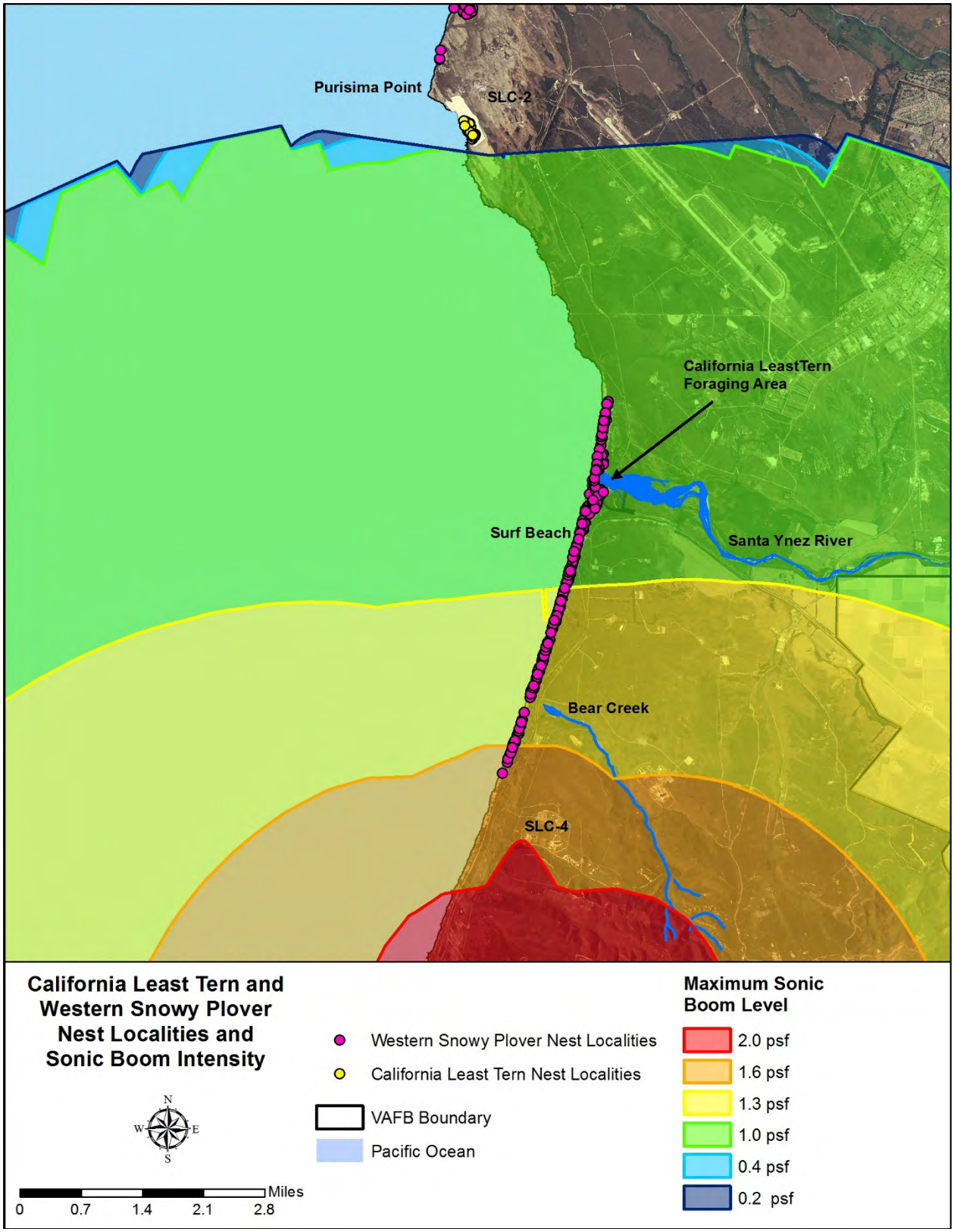


Figure 4-2. Current LETE and SNPL nesting localities and sonic boom intensity

4.4 Western Snowy Plover [Federally Threatened Species]

4.4.1 Status

The USFWS listed the Pacific coast population of the SNPL as federally threatened in March of 1993 (58 FR 12864-12874). The USFWS designated critical habitat for this species in 1999 and revised this designation on 29 September 2005 (70 FR 56969-57119). VAFB was exempted from critical habitat designation under section 4(a)(1) of the ESA.

4.4.2 Life History

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

VAFB provides important breeding and wintering habitat for SNPL. SNPL habitat on VAFB includes all sandy beaches and adjacent coastal dunes from the rocky headlands at the north end of Minuteman Beach to the pocket beaches and dune areas adjacent to Purisima Point on north VAFB (approximately 7.7 miles). Also included are all sandy beaches and adjacent coastal dunes from the rocky headlands at the north end of Wall Beach south to the rock cliffs at the south end of Surf Beach on South VAFB (approximately 4.8 miles). VAFB has consistently supported one of the largest populations of breeding SNPL along the west coast of the United States (Page and Persons 1995). In 2014, VAFB supported an estimated 11 percent of California's breeding population (U.S. Fish and Wildlife Service 2014).

4.4.3 Occurrence within the Proposed Action Area

SNPL nest and overwinter along the coast of VAFB. The nearest observation of a SNPL nest was approximately 0.9 mile northwest of SLC-4. Almost all SNPL nesting habitat on VAFB south of Purisima Point is expected to be impacted by a sonic boom of approximately of 1.0–1.6 psf (Figure 4-2) and would experience landing engine noise between 70 and 100 dB (Figure 2-2).

4.5 Southern Sea Otter [Federally Threatened Species]

4.5.1 Status

The USFWS listed the southern sea otter as federally threatened on 14 January 1977 (42 FR 2965). Critical habitat for this species has not been designated. As a result, the Proposed Action would not affect critical habitat for the sea otter.

4.5.2 Life History

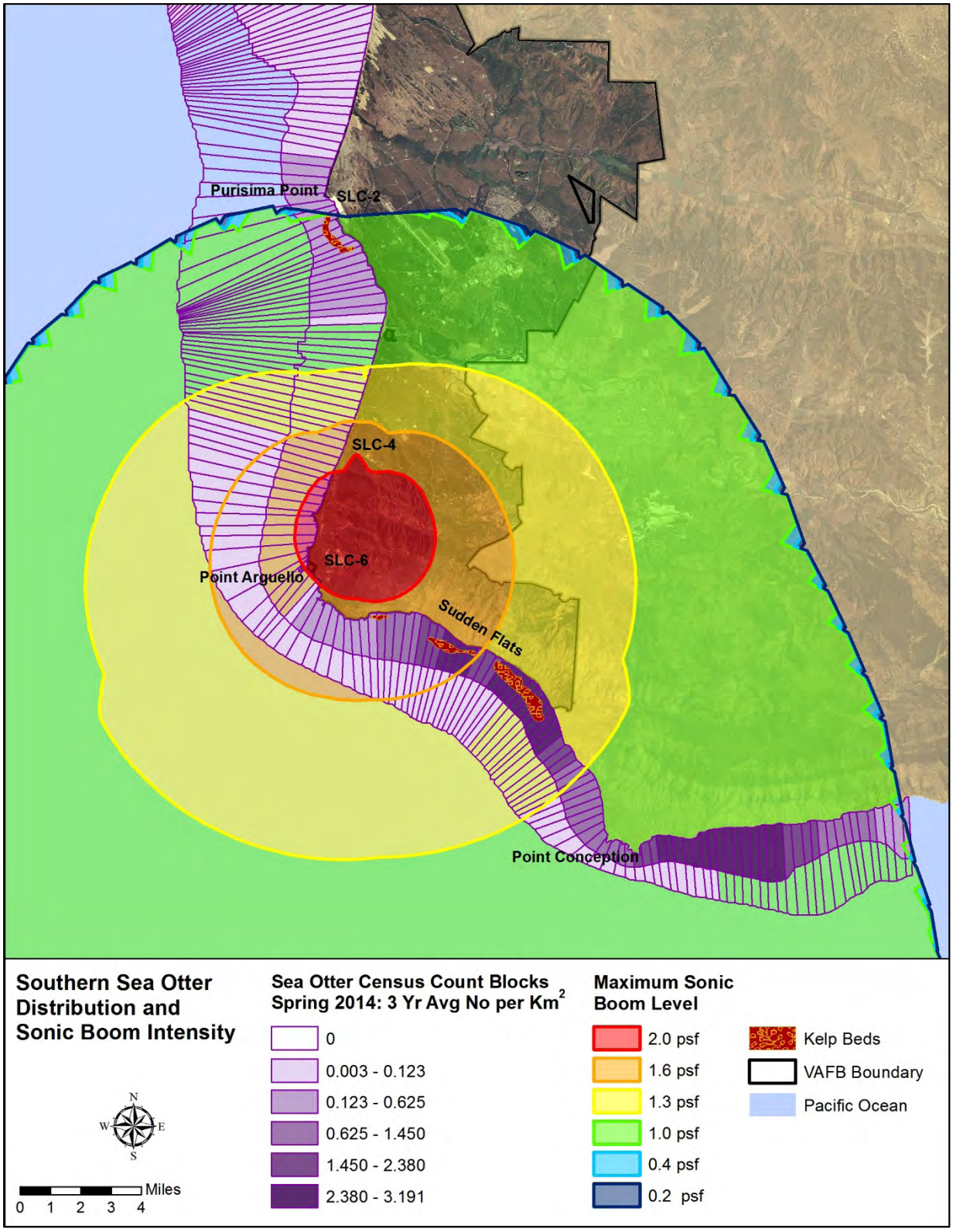
The southern sea otter is the smallest species of marine mammal in North America. It inhabits the nearshore marine environments of California from San Mateo County to Santa Barbara County.

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

Sea otters inhabit the waters along VAFB. Annual surveys by U.S. Geological Survey (USGS) have documented persistent populations in nearshore waters off of Sudden Flats and Purisima Point (United States Geological Survey Western Ecological Resource Center [U.S. Geological Survey Western Ecological Resource Center] 2014). As many as 55 adult otters have been documented in the Sudden Flats area at one time (SRS Technologies, Inc. 2006h), and as many as 18 adult otters have been documented in the Purisima Point area at one time (SRS Technologies, Inc. 2002).

4.5.3 Occurrence within the Proposed Action Area

Southern sea otters occur regularly off the coast of VAFB, with animals typically concentrated in the kelp beds offshore of Purisima Point on north VAFB, and offshore of Sudden Flats on south VAFB (Figure 4-3). VAFB sea otters inhabiting the coast between Purisima Point and Sudden Flats could be impacted by a sonic boom of 1.0-1.6 psf (Figure 4-3). Sea otters inhabiting the kelp beds at Purisima Point and the kelp beds between Point Arguello and Jalama Creek would be expected to experience landing engine noise between 70 and 80 dB (Figure 2-2). Transitory otters traversing the coast between SLC-4 and Point Arguello may be impacted by a sonic boom as high as 2 psf (Figure 4-3) and landing engine noise as great as 110 dB. (Figure 2-2); this area is, however, not regularly occupied and no otters have been detected at this location during the last three annual spring census counts from 2011 to 2014 (U.S. Geological Survey Western Ecological Resource Center 2014).



Sea Otter Data Source: U.S. Geological Survey Western Ecological Resource Center 2014

Figure 4-3. Southern sea otter distribution and sonic boom intensity

4.6 Vegetation Types

Potential physical impacts associated with first stage recovery are expected to be confined to the area of the launch pad. As such, there would be no impacts to vegetation types as a result of the Proposed Action.

5.0 Effects of the Proposed Action

The boost-back and landing of the Falcon 9 first stage would produce a visual disturbance, landing engine noise, and a pressure wave (sonic boom) that may cause short-term disruption of behavior and the elicitation of a startle response, resulting in temporary disturbance to CRLF, LETE, SNPL, and southern sea otters. The activities that may directly or indirectly affect these species include landing noise impacts, visual disturbance, and sonic boom impacts and are discussed below. There would be no impacts to threatened and endangered species habitat since there are no ground disturbing activities associated with the Proposed Action and all direct physical impacts would be confined to the landing pad at SLC-4.

5.1 California Red-legged Frog

South of SLC-4, CRLF populations at Cañada Honda Creek and potentially at Spring Canyon (if present) would be within the overflight zone and thus potentially experience visual disturbance. CRLF from Purisima Point south to Jalama Creek would experience a sonic boom up to 2 psf (Figure 4-1). CRLF in Bear Creek, Cañada Honda Creek, the vicinity of SLC-6, and Spring Canyon (if present), would be expected to experience landing noise over 100 dB (Figure 2-2). All life stages of CRLF can detect noise and vibrations (Lewis and Narins 1985); however; exceptionally little sound is transmitted between the air-water interface (Godin 2008). Thus, in-air sound is not likely to have a significant effect on submerged CRLF. The combined effect of visual and noise-related disturbance would be expected to trigger a startle response in terrestrial CRLF, causing them to flee to water or attempt to hide in place. Any CRLF that dive underwater would be less susceptible to acoustic effects (Godin 2008; U.S. Fish and Wildlife Service 2011a). Since the noise caused by the boost-back and landing of the Falcon 9 first stage would be of short duration (approximately 25-35 seconds), and water would significantly buffer sound for any submerged CRLF, injury to CRLF hearing is highly unlikely. Similarly, a sonic boom of 2 psf is unlikely to result in hearing damage. Therefore, the effects of these visual and auditory stimuli are expected to only cause temporary disruption of CRLF behaviors, including temporary cessation of foraging and, during the breeding season, calling. CRLF would be expected to resume normal activities quickly once the disturbance has ended.

Past monitoring of CRLF response to a launch did not document any adverse effects. CRLF monitoring conducted at Bear Creek for a 2001 launch of an Atlas IIAS MLV-10 from SLC-3E found post-launch counts to be within the range of pre-launch counts and no evidence of mortality, injury, or abnormal behavior (SRS Technologies, Inc. 2001). Previous consultation with USFWS for the Falcon 9 Space Vehicle Program at SLC-4E has concurred that the type of noise-related disturbances discussed above may affect, but are not likely to adversely affect, CRLF (U.S. Fish and Wildlife Service 2011a).

5.2 California Least Tern

Engine landing noise at Purisima Point is expected to be approximately between 70 and 80 dB A-weighted (dBA) and 80–90 dBA at the Santa Ynez River mouth (Figure 2-2). A sonic boom up to 0.2 psf is expected to impact Purisima Point (Figure 4-2). The Santa Ynez River mouth, as shown in Figure 4-2, may be impacted by a sonic boom of up to 1 psf (approximately 130 dB [unweighted]). LETE foraging and breeding areas are not within overflight zone of the boost-back. Visual disturbance is not anticipated as a result of the boost-back and landing due to the distance of the craft from Purisima Point and the Santa Ynez River mouth. In addition, the first stage vehicle would remain above 1,000 feet for the majority of the landing. Flight below 1,000 feet would only occur for 5 seconds.

Behavioral responses are the most commonly used endpoints when studying the effects of noise on wildlife. This is largely based on practical considerations and the difficulty in measuring animal fitness or physiological and ecological endpoints. Researchers have documented a range of behavioral responses to noise, ranging from indifference to extreme panic. Common behavioral responses include alert behavior, startle response, flying or running away, and increased vocalizations (National Park Service 1994; Bowles 1995; Larkin 1996). In some instances, behavioral responses could interfere with breeding, raising young, foraging, habitat use, and physiological energy budgets, particularly when an animal continues to respond to repeated exposures.

While difficult to measure in the field, all behavioral responses are accompanied by some form of physiological response, such as increased heart rate or a startle response. A startle is a rapid, primitive reflex that is characterized by rapid increase in heart rate, shutdown of nonessential functions, and mobilization of glucose reserves. Animals can learn to control the behavioral reactions associated with a startle response and often become habituated to noise (National Park Service 1994; Bowles 1995; Larkin 1996). Habituation keeps animals from expending energy and attention on harmless stimuli, but the physiological component might not habituate completely (Bowles 1995). Therefore, animal fitness could still be affected when an animal has habituated to noise (Barber et al. 2009). Gill et al. (2001) described theoretical circumstances when habituation to or tolerance of a stressor could be more detrimental to a population than a strong avoidance reaction. Nonetheless, what appears to be habituation has been observed in many studies and is well demonstrated in studies evaluating bird control devices (e.g., noise cannons, pyrotechnics, and recorded sounds), which are used to scare birds away from airfields and agricultural areas (Larkin 1996). Larkin (1996) describes one example where red-winged blackbirds began resting on the noise cannon that was intended to scare them away. The birds learned to fly a short distance away when they heard the click of the mechanism that released the gas and signaled an impending explosion.

Likewise, a strong and consistent behavioral or physiological response is not necessarily indicative of negative consequences to individuals or to populations (National Park Service 1994; Bowles 1995; Larkin 1996). For example, many of the reported behavioral and physiological responses to noise are within the range of normal adaptive responses to external stimuli, such as predation, that wild animals face on a regular basis. In many cases, individuals would return to homeostasis or a stable equilibrium almost immediately after exposure. The

individual's overall metabolism and energy budgets would not be affected assuming it had time to recover before being exposed again. If the individual does not recover before being exposed again, physiological responses could be cumulative and lead to reduced fitness. However, it is also possible that an individual would have an avoidance reaction (i.e. move away from the noise source) to repeated exposure or habituate to the noise when repeatedly exposed.

Both the current field and laboratory data indicate that many birds appear to habituate to noise through repeated exposure without long-term discernible negative effects. Loud sonic booms (80-89 dBA SEL) elicited a shorter duration of startle responses than to other disturbances, such as humans on foot, low-flying helicopters, or loud boats (Cooper and Jehl 1980). Monitoring of LETE has been conducted for five Delta II launches from SLC-2 on north VAFB. SLC-2 is 0.4 miles from the Purisima Point nesting colony and significantly closer than SLC-4, which is approximately 7.5 miles from the Purisima Point nesting colony (Figure 4-2). LETE response has been mixed. 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 as a result of the launches (ManTech SRS Technologies, Inc. 2007b, 2008a, 2011). The May and July 1997 Delta II launches, however, potentially caused the abandonment of up to five nests and the death of a chick due to exposure, although predation of adult LETE by owls may have been responsible for some of the losses observed (BioResources 1997). The sound profile for launch noise generated by the Delta II vehicle was characterized at the Purisima Point LETE nesting area during the 15 April 1999 launch (SRS Technologies, Inc. 1999). Sound reaching the recording site had an unweighted peak of 135.5 dB and an unweighted sound exposure level (SEL) of 132.5 dB. The A-weighted SEL was 121.5 dB and the C-weighted SEL was 131.3 dB (SRS Technologies, Inc. 1999). As evidenced in Figure 2-2, sound levels from boost-back and engine landing noise is not expected to reach these levels, and any physiological or behavioral responses are therefore expected to be less than those observed for Delta II rocket launches. Given the distance from SLC-4E and the overflight zone to Purisima Point, and the fact that landing-related noise would be less than that of launch noise, it is unlikely that landing-related noise would cause LETE to alter their behavior at Purisima Point. The Santa Ynez River area (3.7 miles north of SLC-4), occasionally used for foraging, may receive a significant amount of noise, including the impact of 1 psf sonic boom, which could briefly affect foraging behavior. These effects would be short-term and temporary. The proposed monitoring measures (see Section 2.2.2, California Least Tern) are, however, in place to verify that this would be the case. The Proposed Action therefore may affect but is not likely to adversely affect the LETE.

5.3 Western Snowy Plover

SNPL may experience launch-related noise in excess of 100 dBA and a sonic boom of up to 1.6 psf (approximately 130 dB [unweighted]). SNPL monitoring for impacts related to launch-related engine noise and visual disturbance has been conducted during numerous past launches. Direct observations of wintering birds were made during a Titan IV and Falcon 9 launch from SLC-4E (SRS Technologies, Inc. 2006d; Robinette and Ball 2013). Both the Titan IV and Falcon 9 are larger, louder (130 dBA and 100 dBA respectively) launch vehicles than the

Falcon 9 first stage boost-back. SNPL did not exhibit any adverse reactions to these launches (SRS Technologies, Inc. 2006d; Robinette and Ball 2013). Additionally, monitoring of SNPL during the breeding and non-breeding season for other launches has routinely demonstrated that SNPL behavior is not adversely affected by launch noise or vibrations, and no incidents of injury or mortality to adults, young, or eggs have been documented following any of the launches (SRS Technologies, Inc. 2006a, 2006b, 2006c, 2006f, 2006g, 2006h, 2006i; ManTech SRS Technologies, Inc. 2007a, 2008b, 2008c, 2009e).

Similar to LETE, due to the short-term, transient nature of anticipated boost-back and sonic boom noise and their lack of adverse responses to rocket launch noise, responses to boost-back noise are only anticipated to be behavioral. These behavioral reactions would likely be short term (minutes) and would be unlikely to cause long-term consequences for individuals or populations. The proposed monitoring measures (see Section 2.2.3, Western Snowy Plover) are in place to verify that this would be the case. The Proposed Action therefore may affect but is not likely to adversely affect SNPL.

5.4 Southern Sea Otter

Areas where sea otters may be present would be impacted by landing noise and sonic boom noise of up to 135 dB. Sea otter rafting areas off Purisima Point and Sudden Flats are projected to receive a sonic boom with pressure levels between 1 and 1.6 psf (Figure 4-3). Additionally, otters in transit along the coast southwest of SLC-4 may be impacted by a sonic boom as high as 2 psf (Figure 4-3). The response to sonic booms or other sudden disturbances is similar among many species (Moller 1978). Sudden and unfamiliar sounds usually act as an alarm and trigger a "fight or flight" startle reaction. However, sonic booms are not expected to cause more than a temporary startle-response because the "pursuit" would not be present, as monitoring sea otters during launch operations has indicated that launch noise is not a primary driver of sea otter behavior. Additionally, USFWS has stated that they had no evidence that defense-related activities have had any adverse effects on the well-monitored experimental population of southern sea otters at San Nicolas Island or in the Southern California Range Complex (U.S. Fish and Wildlife Service 2011).

Launch monitoring of sea otters on both north and south VAFB has been extensive, with pre- and post-launch counts and observations conducted at rafting sites immediately south of Purisima Point for numerous Delta II launches from SLC-2 and one Taurus launch from SLC-576 (Taurus launch site), and at the rafting sites off of Sudden Flats for two Delta IV launches from SLC-6. No abnormal behavior, mortality, or injury has ever been documented for sea otter as a result of launch-related disturbance (SRS Technologies, Inc. 2006a, 2006c, 2006e, 2006f, 2006h, 2006i, 2007; ManTech SRS Technologies, Inc. 2007a, 2007b, 2007c, 2008a, 2008b, 2008c, 2008d, 2008e, 2009c, 2009d, 2010). During the Delta IV launches, the number of sea otters observed after launch activities was similar to or greater than pre-launch counts. Given these observations, any launch-related effects on sea otter populations are likely negligible and temporary. In addition, the past launches during which monitoring of sea otters was conducted involved launch vehicles that produced louder noise than the boost-back is expected to produce.

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

Sounds from rocket launches are typically at a maximum at initiation of the booster rockets. These sounds (including any sonic booms from supersonic flight) would be transient and of short duration, lasting no more than a few seconds at any given location. Launch and boost-back activities may expose sea otters to levels of sound that could produce brief startle reactions or diving. However, while a 2 psf boom is approximately 135 dB (unweighted), it is likely that most of that acoustic energy is not heard by sea otters. Figure 5-1 illustrates the frequency spectrum of a 1.5 psf sonic boom (recorded at San Nicholas Island on 12 December 2014) as well as the hearing curve of a sea otter (Ghoul and Reichmuth 2014). Most of the sonic boom energy is less than 250 hertz (Hz), well below the region of best sensitivity of the sea otter (2–22.6 kHz; Figure 5-1). While the sea otter would likely hear the sonic boom, it would only be responding to acoustic energy that is above 250 Hz and total sound levels much less than 135 dB.

Due to the short-term, transient nature of anticipated boost-back and sonic boom noise, lack of overlap of hearing sensitivity with majority of sonic boom noise, and their lack of adverse responses to rocket launch noise, it is anticipated that responses to boost-back noise would only be behavioral. Behavioral reactions would likely be short term (minutes) and would be unlikely to cause long-term consequences for individuals or populations. Therefore, the proposed action may affect but is not likely to adversely affect the southern sea otter.

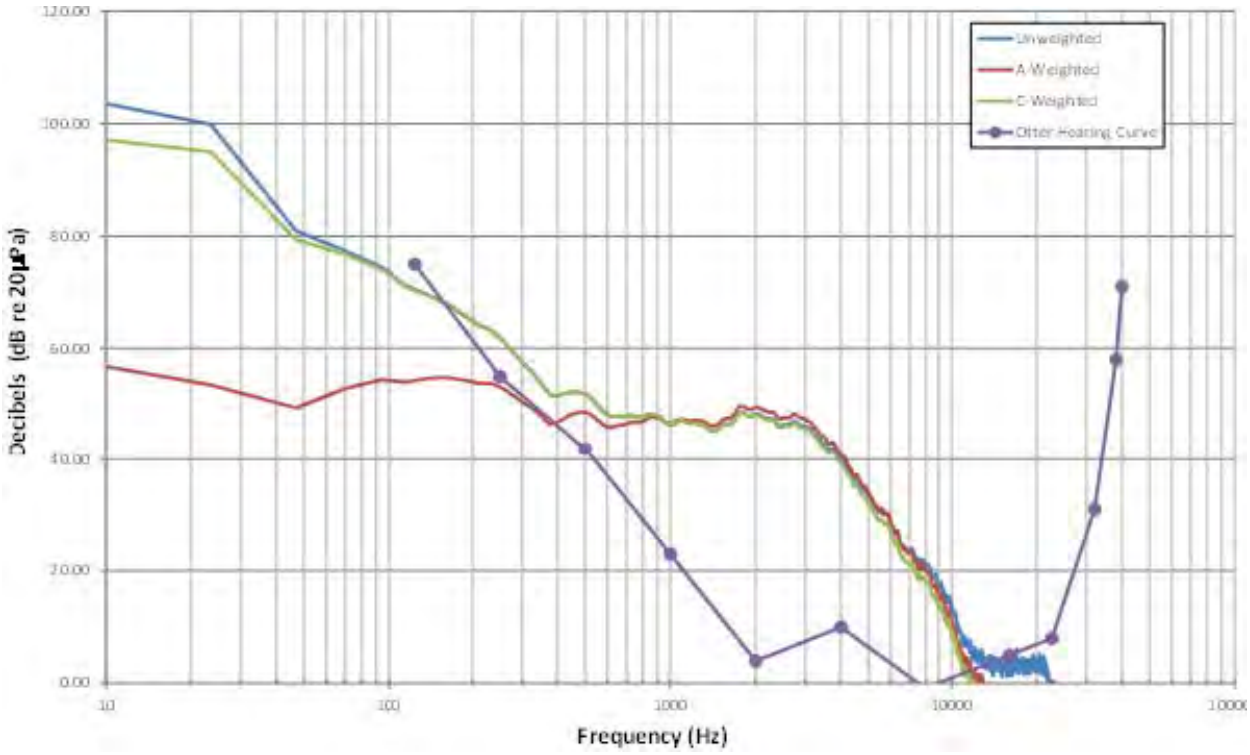


Figure 5-1. Sonic boom spectrum and sea otter hearing sensitivity curve

6.0 Interrelated and Interdependent Actions

The boost-back and landing of the Falcon 9 first stage is directly related to the Falcon 9 Launch Program. All first stage return flights (boost-back and landing) would occur in conjunction with a Falcon 9 launch. In June 2011, USFWS concurred with the USAF assessment that Falcon 9 launch noise was likely to affect, but not likely to adversely affect, CRLF, LETE, SNPL, and southern sea otter (8-8-11-F-32R).

7.0 Cumulative Impacts

Cumulative effects are defined in 50 Code of Federal Regulations §402.02 (Interagency Cooperation on the ESA of 1973, as amended): "…those effects of future State or private activities not involving Federal activities that are reasonably certain to occur within the action area of the Federal action subject to consultation." Reasonable foreseeable future federal actions and potential future federal actions that are unrelated to the Proposed Action are not considered in the analysis of cumulative effects because they would require separate consultation pursuant to section 7 of the ESA.

Cumulative effects include the effects of future State, tribal, local, or private actions that are reasonably certain to occur in the action area. Future federal actions unrelated to the proposed action would require separate consultation under section 7 of the ESA. There are no known cumulative effects related to the actions planned at SLC-4.

8.0 ESA Determination Conclusions

Tables 8-1 summarize the Air Force's ESA determinations of effects of the Proposed Action for each of the species analyzed in this Biological Assessment.

Table 8-1. Endangered Species Act determinations of effects of the boost-back and landing of the Falcon 9 first stage

Species	Endangered Species Act Determination of Effect on the Species
California Red-Legged Frog (*Rana draytonii*)	May affect, not likely to adversely affect
California Least Tern (*Sterna antillarum browni*)	May affect, not likely to adversely affect
Western Snowy Plover (*Charadrius nivosus*)	May affect, not likely to adversely affect
Southern Sea Otter (*Enhydra lutris nereis*)	May affect, not likely to adversely affect

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DEPARTMENT OF THE AIR FORCE
30TH SPACE WING (AFSPC)

JUN 0 4 2015

Beatrice L. Kephart
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1028 Iceland Ave
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Mr. Stephen P. Henry
U.S. Fish and Wildlife Service
Ventura Fish and Wildlife Office
2493 Portola Road, Suite B
Ventura CA 93003

Dear Mr. Henry

On April 14, 2015, my office submitted a letter requesting your concurrence that planned Falcon 9 boostback and landing actions at Space Launch Complex 4 West (SLC-4W) "may affect, but are not likely to adversely affect" (NLAA) the California red-legged frog (*Rana draytonii,* CRLF), California least tern (*Sternula antillarum browni*), the Western snowy plover (*Charadrius nivosus*) or the Southern sea otter (*Enhydra lutris nereis*). Since that time Space Exploration Technologies Corporation (SpaceX) has changed the project description to include potential boost-back landings 50 km offshore of VAFB on a barge or on the water. Although neither of these options are anticipated to have any adverse effects on federally listed endangered species regulated by your office, we wanted to formally change the project description for this action and inform you of our "no effect" determination for these contingency landing actions. We are formally including the Biological Assessment for your review.

Please contact me at (805) 605-7924 or Darryl York at (805) 605-8684 with any questions.

Sincerely

BEATRICE L. KEPHART
Chief, Installation Management Flight

Attachment:
Biological Assessment

ManTech International Corporation
ManTech SRS Technologies, Inc.
102 East Ocean Ave.
Lompoc, CA 93436

2 June 2015

John Hauenstein
Environmental Health and Safety Manager
Space Exploration Technologies Corporation
Vandenberg AFB, CA 93437

SUBJECT: Biological Assessment of the Contingency Landing Actions for the Boost-back and Landing of the Falcon 9 First Stage

Dear Mr. Hauenstein,

Space Exploration Technologies Corporation (SpaceX) has added a contingency action to the proposed action analyzed in the Biological Assessment for Boost-Back Landing of the Falcon 9 First Stage at SLC-4 West, Vandenberg Air Force Base (VAFB), California (ManTech SRS Technologies, Inc. 2015). SpaceX added the following two contingency landing actions for the Falcon 9 first stage: 1) landing the first stage on a barge in the Pacific Ocean at a contingency landing location 50 kilometers (km) offshore of VAFB; and 2) landing the first stage in the water at the same contingency landing location 50 km offshore. The two contingency actions are described in detail below, followed by an analysis of their potential impacts on federally listed species under the jurisdiction of the United States Fish and Wildlife Service (USFWS) as required by section 7 of the Endangered Species Act (ESA).

PROPOSED CONTINGENCY ACTIONS

Contingency Barge Landing

If the Falcon 9 first stage is unable to land at Space Launch Complex (SLC)-4W, the first stage would land on a barge, specifically designed to be used as a landing platform for the first stage. The barge would be located no less than 50 km offshore of VAFB (Figure 1).

Three vessels would be required for a barge landing:

1. Barge/Landing Platform – approximately 300 ft. long and 150 ft. wide (Figure 2)
2. Support Vessel – approximately 165 ft. long research vessel
3. Ocean Tug – 120 ft. open water commercial tug

The Support Vessel is a 165 ft. long research vessel that is capable of housing the crew, instrumentation and communication equipment, and will support debris recovery efforts, if

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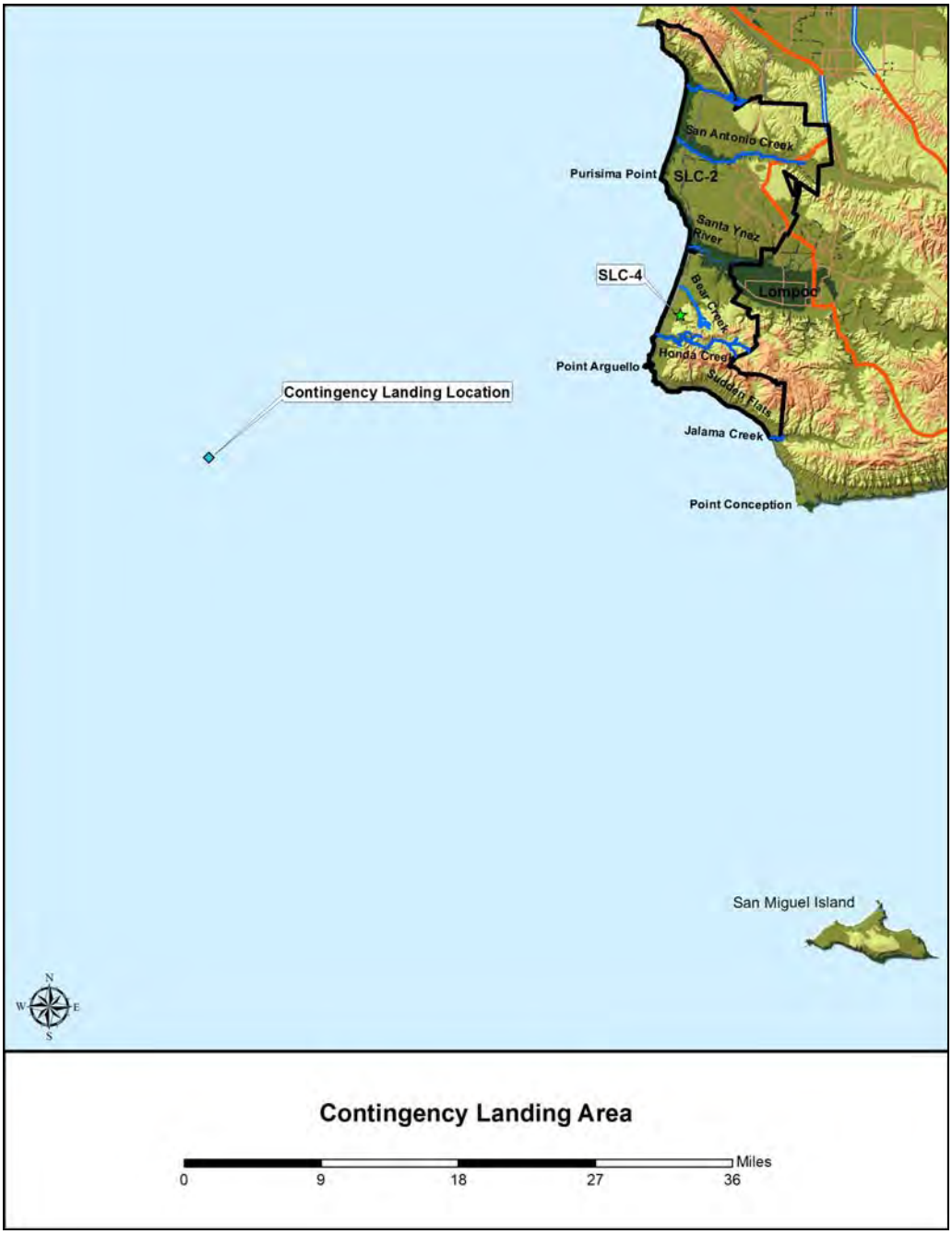

Figure 1. Contingency Landing Location.

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necessary. The Tug is a 120 ft. open-water commercial ocean vessel. The primary operation of the tug is to tow the barge into position at the landing site and tow the barge and rocket back to Long Beach Harbor. After landing, the first stage would be secured onto the barge and transported to the Long Beach Harbor for off-loading and transport back to the SLC-4W pad. Hazardous materials would be off-loaded from the first stage after the barge is docked in Long Beach Harbor. Any debris collected at the landing site would also be transported to Long Beach Harbor to be offloaded and properly discarded. No vessels would travel to or utilize the VAFB Harbor.

Figure 2. Barge landing platform.

Contingency Water Landing

As a contingency action to landing the Falcon 9 first stage on the SLC-4W pad at VAFB or on a barge, SpaceX proposes landing the first stage in the ocean no less than 50 km offshore of VAFB at the same contingency landing location described above (Figure 1). Two scenarios for a water landing are possible: (1) prior to launch, a decision is made that only a water landing would be attempted and no attempt would be made to land on the barge; and (2) a barge landing is

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planned, but ocean conditions are unfavorable for a successful landing. In the first scenario, only the support vessel would be used to recover floating debris and to ensure no hazards to navigation are present in the vicinity of the landing site. Neither the barge nor tug would be used.

In the second scenario, the barge, tug, and support vessel would be at the landing site in preparation for a barge landing, but if ocean conditions are too rough (the barge can only operate as a landing platform when ocean waves are less than 13 ft. and winds are less than 27 knots), the barge landing attempt would be called off, and a water landing would take place. The support vessel would already be onsite and would proceed with recovering debris following the water landing.

The fuel tanks would explode upon impact with the water surface, thus most of the remaining rocket propellant (RP-1) would be burned in a contingency water landing. The explosive equivalence of the first stage with maximum fuel and oxidizer is 943.4 lbs. of TNT. This amount of TNT would be capable of generating a projectile range of 1,250 ft. from the point of impact. Past experience with water landings has demonstrated that the first stage is not recoverable during boost-back attempts where landing occurs at-sea. Under either scenario, any debris collected at the landing site would be transported to Long Beach Harbor to be offloaded and properly discarded. No vessels would travel to or utilize the VAFB Harbor.

POTENTIAL IMPACTS TO FEDERALLY LISTED SPECIES

Debris

SpaceX has experience performing recovery operations after water and unsuccessful barge landings for numerous Falcon 9 first stage landing attempts. This experience, in addition to the debris catalog that identifies all floating debris, has revealed that approximately 25 pieces of debris remain floating after a water landing or an unsuccessful barge landing. All other debris sinks to the bottom of the ocean. These 25 pieces of floating debris are primarily made up of Carbon Over Pressure Vessels (COPVs), the liquid oxygen fill line, and carbon fiber constructed landing legs. SpaceX has performed successful recovery of all of these floating items during previous landing attempts. No floating debris would impact the State Marine Preserve or impact California beaches. All recovered debris would be transported back to Long Beach Harbor. There would be no need to utilize the VAFB Harbor for this action. As a result, floating debris as a result of a water or unsuccessful barge landing would have no effect on federally listed species under the jurisdiction of the USFWS.

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Rocket Propellant

At most, the first stage would contain 400 gallons of RP-1 on board. In the event of a water landing or unsuccessful barge landing, most of this fuel would be consumed during the subsequent explosion. Residual fuel (estimated to be between 50 and 150 gallons) would be released into the ocean. Final volumes of fuel remaining in the first stage upon impact may vary, but are anticipated to be below the high range estimations.

RP-1 is a Type 1 "Very Light Oil", which are characterized as having low viscosity, low specific gravity and are highly volatile (U.S. Fish and Wildlife Service 1998). Due to its high volatility, RP-1 evaporates quickly when exposed to the air, and would completely dissipate within one to two days after a spill. Clean-up following a spill is usually not possible with spills of very light oil, particularly with such a small quantity of oil (U.S. Fish and Wildlife Service 1998). Therefore, no attempt would be made to boom or recover RP-1 fuel from the ocean.

RP-1 on the water surface would move with the water flow, being transported due to the velocities in the surface layer. As such, the prevailing current, tide, and wind patterns offshore of VAFB would tend to move the RP-1 in a clockwise pattern in a predominately south-south-east direction (Tetra Tech, Inc. 2015). Surface debris modeled in this fashion at 7.0 to 12.0 km offshore, were unlikely to reach the VAFB shoreline within 24 hours (Tetra Tech, Inc. 2015). The contingency landing location is 50 km offshore to the west of VAFB and approximately 80 km northwest of San Miguel Island. Thus at over 7 to 10 times the distance offshore, there would be ample time for the RP-1 to completely dissipate before reaching the shore or nearshore habitats (e.g. kelp beds). In the event of adverse ocean conditions (e.g., large swells, large waves) and weather conditions (e.g., fog, rain, high winds) RP-1 would be volatilized more rapidly due to increased agitation and thus dissipate even more quickly.

Therefore, in the event of a release of RP-1 after a water landing or unsuccessful barge landing, there would be no effect on federally listed species under the jurisdiction of the USFWS.

Sonic Boom

During descent, a sonic boom (overpressure of high energy impulsive sound) would be generated while the first-stage booster is supersonic. The overpressure would be directed at the ocean surface 50 km off the coast of VAFB. A noise analysis was performed for a boost-back landing on the pad a VAFB, and it was determined sonic overpressures would reach as high as 2.0 pounds per square foot (psf) approximately 3.7 km south of SLC-4 and within the boundary of VAFB (Wyle 2015). The SLC-4W pad-based landing overpressure modeling was roughly extrapolated to show potential noise impacts for landing 50 km to the west of VAFB (Figure 3).

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This extrapolation suggests that the maximum overpressure that would impact land during a barge or water landing would be 0.4 psf and the Northern Channel Islands may experience a sonic boom of 0.2 psf (Figure 3).

The Biological Assessment for the Falcon 9 first stage boost-back and landing at SLC-4W analyzed the potential effects of a sonic boom up to 2.0 psf impacting land (ManTech SRS Technologies, Inc. 2015). Since the contingency landing location is 50 km offshore, the sonic booms that may impact land would be much less powerful (up to 0.4 psf; Figure 3). As a result, the associated potential impacts to federally listed species are expected to be less, or at most similar. Therefore, sonic booms generated by the proposed contingency actions may affect, but are not likely to adversely affect the California red legged frog (*Rana draytonii*), the California least tern (*Sterna antillarum browni*), the western snowy plover (*Charadrius nivosus*), and the southern sea otter (*Enhydra lutris nereis*).

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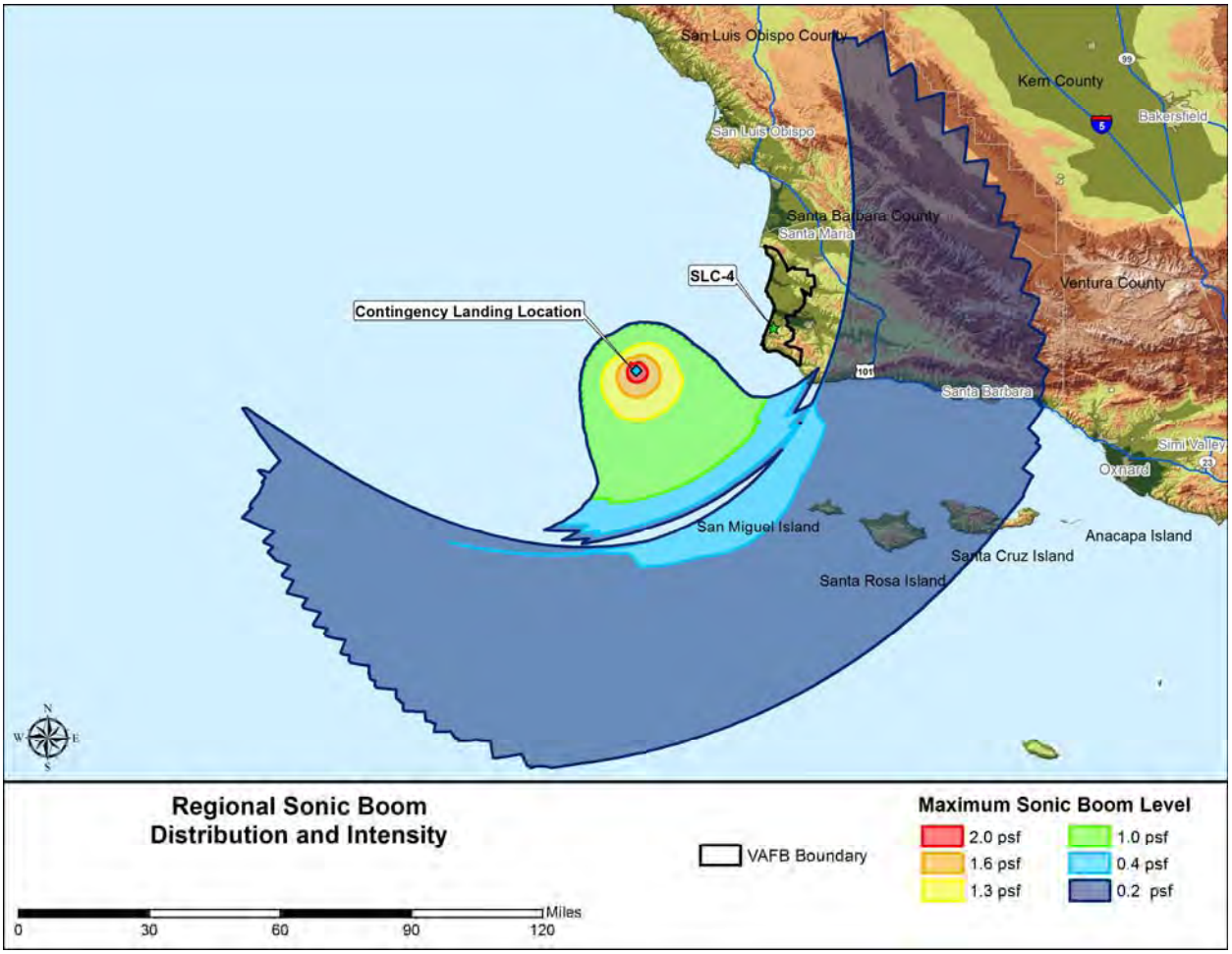

Figure 3. Hypothetical Sonic Boom Overpressure for Contingency Actions of Barge or Water Landing at the Contingency Landing Location.

Landing Noise

Engine noise would also be produced during the barge landing of the Falcon 9 first stage; similar to the sonic boom intensity estimation, data extrapolation from the pad landing suggests that engine noise would not be heard on land from this action (Figure 4). As a result, landing noise would have no effect on federally listed species under the jurisdiction of the USFWS.

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Figure 4. First Stage Landing Engine Noise at the Contingency Landing Location.

SUMMARY OF CONCLUSIONS

The effects of the proposed contingency action on federally listed species under the jurisdiction of the USFWS are less than or similar to the effects of the boost-back and landing of the Falcon 9 first stage at SLC-4W. Table 1 summarizes these potential effects.

Table 1. ESA determinations of effects of the proposed contingency actions.

Potential Stressor	Federally-Listed Species			
	California Red-Legged Frog	California Least Tern	Western Snowy Plover	Southern Sea Otter
Debris	No Effect	No Effect	No Effect	No Effect
Fuel Release	No Effect	No Effect	No Effect	No Effect
Sonic Boom	NLAA*	NLAA*	NLAA*	NLAA*
Landing Noise	No Effect	No Effect	No Effect	No Effect

* NLAA = May affect, but not likely to adversely affect.

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REFERENCES

ManTech SRS Technologies, Inc. 2015. Biological Assessment for Boost-Back Landing of the Falcon 9 First Stage at SLC-4 West, Vandenberg Air Force Base, California. Prepared for Space Exploration Technologies Corporation and Vandenberg Air Force Base. 38 pp.

Tetra Tech, Inc. 2015. Debris Migration Modeling Associated with Falcon 9 In-Flight Abort Test, Vandenberg Air Force Base, California. Prepared for Space Exploration Technologies Corporation.

U.S. Fish and Wildlife Service. 1998. Oil and Nature. New England Field Office. Available at: https://www.fws.gov/contaminants/Documents/OilAndNature.pdf.

Wyle Environment and Energy Research and Consulting. 2015. Noise and Sonic Boom Assessment of Falcon 9 Landing at Vandenberg AFB. Prepared for Tetra Tech, Inc.

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United States Department of the Interior

FISH AND WILDLIFE SERVICE
Ventura Fish and Wildlife Office
2493 Portola Road, Suite B
Ventura, California 93003

IN REPLY REFER TO:
08EVEN00-2015-I-0208

July 2, 2015

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

Subject: SpaceX Boost-Back Landing Operations, Space Launch Complex 4 West, Vandenberg Air Force Base, Santa Barbara County, California

Dear Ms. Kephart:

This letter is in response to your inquiry, dated April 15, 2015, and modified on June 4, 2015, requesting our concurrence with your determination that the Falcon 9 boost-back landing operations at Space Launch Complex 4 West (SLC-4W), on Vandenberg Air Force Base (AFB) and at sea, may affect but are not likely to adversely affect the federally threatened California red-legged frog (*Rana draytonii*), western snowy plover (*Charadrius nivosus nivosus*), and southern sea otter (*Enhydra lutris nereis*), and endangered California least tern (*Sternula antillarum browni*). Your request and our response are in accordance with section 7 of the Endangered Species Act (Act) of 1973, as amended (16 U.S.C. 1531 et seq.).

Space Exploration Technologies Corporation (SpaceX) is currently operating the Falcon 9 Launch Vehicle Program at SLC-4 East (E). We consulted on the modification and use of SLC-4E to support the Falcon 9 and Falcon 9 Heavy Programs in 2011. We completed a second consultation in 2014 that included an operational check, abort test, a one-time test of a new technology in recovering rocket boosters, referred to as "boost-back landing", and infrastructure improvements at SLC-4W, which were not anticipated at the time the initial consultations relating to the Falcon Vehicle Program were conducted.

SpaceX is proposing to incorporate boost-back landings as a standard component of future launch operations at Vandenberg AFB. SpaceX anticipates a maximum of 10 launches from SLC-4E, and subsequent boost-back landings at SLC-4W, during any given year. Alternatively to landing at SLC-4W, SpaceX may land boosters at sea, either on a barge or directly into the ocean approximately 31 miles (50 kilometers) offshore. During descent of the booster, a sonic boom[1] would be generated while the first-stage booster is supersonic. When landing at SLC-4W, the overpressure wave would be directed at the

[1] Sonic booms are categorized as high energy impulsive sound that are associated with the pressure waves created by an object traveling through the air faster than the speed of sound. The intensity of the pressure wave depends on, among other factors, the quantity of air being accelerated, and is dependent on the size and shape of the object. The overpressure measure is the increase over normal atmospheric pressure (2,116 psf). Modern supersonic aircraft generate overpressures varying from less than 1 psf to about 10 psf.

coastal area south of SLC-4 and would reach as high as 2.0 pounds per square foot (psf). Engine noise would also be produced during the landing of the Falcon 9 first stage, but it would be less than the noise generated during the launch[2]. While no habitat for listed species would be directly impacted by boost-back landings at SLC-4W or at sea, individual California red-legged frogs, California least terns, western snowy plovers, and southern sea otters occur within the area affected by the boost-back landing sonic boom overpressure wave.

The Air Force and SpaceX proposed the following monitoring measures. The biological assessment (Mantech SRS Technologies 2015) contains additional details.

1. Monitor California least terns nesting within the area predicted to experience an overpressure wave greater than 1 psf during a minimum of the first three boost-back landing operations that occur during the tern nesting season.
2. Monitor western snowy plovers nesting within the area predicted to experience an overpressure wave greater than 1 psf during a minimum of the first three boost-back landing operations that occur during the plover nesting season.
3. Monitor southern sea otters occurring within any area predicted to experience an overpressure wave greater than 1 psf during a minimum of the first three boost-back landing operations.

California Red-Legged Frog

The nearest California red-legged frog breeding habitat to SLC-4 is located approximately 200 feet (61 meters) south of SLC-4W in Spring Canyon. Spring Canyon is an ephemeral drainage and has not contained water for the last 2 years due to drought conditions. Protocol-level surveys have not been conducted for California red-legged frogs within Spring Canyon; however, this species has potential to occur in various aquatic habitats, including natural and artificial ponds and reservoirs, streams and other watercourses, freshwater lagoons, springs, and seeps. The nearest documented California red-legged frog location to SLC-4 is 1.53 miles (2.5 kilometers) south in the Bear Creek lagoon. California red-legged frogs have also been documented in Honda Creek 1.9 miles (3.1 kilometers) south of SLC-4. There is no evidence that the short duration of noise and/or light exposure during launch events causes any adverse effects to amphibians, and based on our knowledge of the species, we would not expect any effects beyond a short-term startle response. Additionally, water quality is not anticipated to be affected by project activities.

California Least Tern

While Vandenberg AFB only supports a relatively small percentage of all known breeding California least terns, as one of only three breeding colonies found between Monterey and Point Conception, the population that nests on Purisima Point is important. The Purisima Point breeding colony is approximately 8 miles (12.9 kilometers) north of SLC-4W and is within an area expected to receive landing engine noise within 70–80 decibels (dB) when a booster lands at SLC-4W, and a sonic boom overpressure wave up to 0.2 psf. California least terns nesting at Vandenberg AFB are anticipated to

[2] Sound is technically a pressure fluctuation in the atmosphere and ears respond to sound pressure in a logarithmic manner. Sound pressure levels are measured with the logarithmic scale, which corresponds to the biological properties of the human ear that determine sound loudness perception, with zero being the sound level the human ear can hear and a value of 120 decibels (dB) is approximately the point at which the sound becomes painful.

experience an overpressure wave of less than 0.2 psf when SpaceX lands a booster at sea, and experience no landing noise.

The effect of launch noise from SLC-4 on California least terns has not been monitored, but the Air Force has monitored impacts of launch noise from SLC-2, which is less than a half mile (0.6 kilometers) from the nesting colony, with mixed results: launches did not cause any detectable effects on nesting California least terns during launches in 2008 and 2011, but potentially caused abandonment of 5 nests in 1997. Given that the sound level recorded at the nesting colony from launches at SLC-2 was recorded at 135.5 (dB), and projected noise levels at the colony due to boost-back landing noise from SLC-4W are less than 80 dB, effects are not expected beyond a short-term startle response. Likewise, the overpressure wave from the sonic boom anticipated during the boost-back landing is modeled to be less than 0.2 psf and not expected to cause adverse effects.

The Santa Ynez River lagoon is approximately 3.7 miles (6.0 kilometers) north of SLC-4W, and California least tern foraging there are expected to experience landing engine noise up to 80–90 dB, and experience a sonic boom overpressure wave up to 1 psf, which could briefly affect foraging behavior. These effects are anticipated to be short-term and temporary and have no adverse effects. Neither the breeding colony nor the foraging area is within the overflight zone so no visual impacts are anticipated.

Western Snowy Plover

Western snowy plover nest and overwinter along the coast of Vandenberg AFB, and the nearest nesting area to SLC-4 is just under 1 mile (1.6 kilometers) to the north. The Air Force anticipates that when landing a booster at SLC-4W, nearly all western snowy plover nesting habitat in the southern portion of the base would experience a sonic boom overpressure wave of approximately of 1.0–1.6 psf and would experience boost-back landing noise between 70 and 100 dB. Western snowy plovers nesting at Vandenberg AFB are anticipated to experience an overpressure wave of less than 0.2 psf when SpaceX lands a booster at sea, and experience no landing noise.

The Air Force has monitored both nesting and wintering western snowy plover at Vandenberg AFB for impacts related to launch noise (up to 130 dB) and visual disturbance during numerous past launches, with no adverse effects detected. Additionally, the Air Force has monitored western snowy plovers during the breeding and non-breeding seasons during launches from other launch complexes and has routinely demonstrated that western snowy plover are not adversely affected by launch noise or vibrations, and no incidents of injury or mortality to adults, young, or eggs have been documented following any of the launches. Due to the short-term, transient nature of the anticipated boost-back landing overpressure wave, and their lack of adverse responses to rocket launch noise, adverse effects are not anticipated.

Southern Sea Otter

Southern sea otters occur regularly off the coast of Vandenberg AFB, with animals typically concentrated in the kelp beds offshore of Purisima Point on the north portion of base, and offshore of Sudden Flats in the southern portion. The Air Force anticipates that sea otters inhabiting the coast between Purisima Point and Sudden Flats could be impacted by a sonic boom overpressure wave of 1.0-1.6 psf due to boost-back landing activities. Sea otters inhabiting the kelp beds at Purisima Point and the kelp beds between Point Arguello and Jalama Creek would be expected to experience landing engine noise between 70 and 80 dB. Should any otters be traversing the coast between SLC-4 and Point Arguello during a boost-back landing, they would experience a sonic boom overpressure wave as high as 2 psf and landing engine noise

as great as 110 dB. However, this area is not regularly occupied and no otters have been detected at this location during the last three annual spring censuses (U.S. Geological Survey Western Ecological Resource Center 2014). Sea otters do not occupy the portion of the ocean where at-sea booster landings may occur.

In an attempt to develop effective ways to deter sea otters from oil spills, Davis (1988) found that otters presented with a random assortment of synthetic sounds (up to 190 dB) exhibited a startle response, but habituated within 2 hours and did not avoid the sound source. Ghoul and Reichmuth (2014) analyzed aerial hearing thresholds in captive sea otters, and found that otter hearing is most sensitive to sound frequencies between 2 and 26 kilohertz (kHz), whereas most of the sonic boom energy is less than 250 hertz (Hz), well below the sea otter's region of hearing sensitivity.

The Air Force has extensively monitored sea otters during launches at Vandenberg AFB, with pre- and post-launch counts and observations conducted at rafting sites for numerous launches from different launch complexes. The Air Force has not detected any abnormal behavior, mortality, or injury of sea otters as a result of any launches, including those involving launch vehicles that produced louder noise than the boost-back landing is expected to produce. Due to the short-term, transient nature of anticipated boost-back landing sonic boom noise and overpressure wave, and the lack of sea otter hearing sensitivity in the range of the sonic boom noise, boost-back landings at SLC-4W are not expected to cause more than a temporary startle-response, and adverse effects are not anticipated.

In conclusion, we concur with your determination that the proposed project may affect, but is not likely to adversely affect the California red-legged frog, California least tern, western snowy plover, and southern sea otter. We have concluded that any potential adverse effects resulting from the proposed project would be insignificant (i.e., the size of the impact would be so small that a person would not be able to meaningfully measure, detect, or evaluate the effects) and discountable (i.e., the effects are extremely unlikely to occur).

This concludes informal consultation on SpaceX boost-back landings at SLC-4W or at sea pursuant to section 7(a)(2) of the Act. If the proposed action changes in any manner or if new information reveals that listed species in the project area may be adversely affected by the proposed action, the Air Force should contact us immediately and suspend all activities that may affect listed species until the appropriate level of consultation is completed.

If you have any questions regarding this matter, please contact Bill Standley at (805) 644-1766, extension 315.

Sincerely,

Jeff Phillips
Deputy Assistant Field Supervisor

REFERENCES

Davis, R.W., T.M. Williams and F. Awbrey. 1988. Sea Otter Oil Spill Avoidance Study. Minerals Management Service. OCS Study MMS-88-0051.

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

ManTech SRS Technologies, Inc. 2015. Biological Assessment for Boost-Back Landing of the Falcon 9 First Stage at SLC-4 West, Vandenberg Air Force Base, California. Prepared for Space Exploration Technologies Corporation and 30th Space Wing, Installation Management Flight, Vandenberg Air Force Base, California. April 15, 2015.

United States Geological Survey Western Ecological Resource Center. 2014. Sea otter census data from 2014 spring surveys. http://www.werc.usgs.gov/ProjectSubWebPage.aspx?SubWebPageID=4&ProjectID=91

APPENDIX E: National Oceanic and Atmospheric Administration, National Marine Fisheries Service Consultations

DEPARTMENT OF THE AIR FORCE
30TH SPACE WING (AFSPC)

Ms. Beatrice L. Kephart
30 CES/CEI
1028 Iceland Avenue
Vandenberg AFB CA 93437-6010

JUN 0 4 2015

Mr. Will Stelle
NOAA Fisheries Service
Southwest Region
501 West Ocean Blvd, Ste 4200
Long Beach CA 90802-4213

Dear Mr. Stelle

Vandenberg Air Force Base (VAFB) is providing information on the SpaceX Boost-Back and Landing of the Falcon 9 First Stage at Space Launch Complex 4-West (SLC-4 W) on VAFB in order to assist in the analysis of the impacts of the Proposed Action on Essential Fish Habitat (EFH, Attachment 1). Our determination, for which we request your concurrence, is that the Boost-Back project as described below and in the attachment "may adversely affect Essential Fish Habitat," however only "temporary and no more than minimal effects" are expected.

Under the Proposed Action, SpaceX would land the Falcon 9 First Stage on the pad at SLC-4 W. However, one of two contingency landings are also possible: a barge landing occurring approximately 50 km west of VAFB in the Pacific Ocean and a water landing in approximately the same location. Up to six launches and First Stage landings would occur per year, with the first launch scheduled for late July 2015. The two offshore contingency landings have the potential to impact EFH and are discussed in this letter.

After separation and first stage engine cutoff, exoatmospheric cold gas thrusters would be triggered to flip the first stage into position for retrograde burn. Three of the nine first stage Merlin engines would be restarted to conduct the retrograde burn in order to reduce the velocity of the first stage and to place the first stage in the correct angle to land (Figure 1). Once the First Stage is in position and approaching its landing target, the three engines would be cut off to end the boost-back burn. The first stage would then perform a controlled descent using atmospheric resistance to slow the stage down and guide it to the landing site (barge or water) (Figure 2). The first stage is outfitted with grid fins that allow cross range corrections as needed. The landing legs on the first stage would then deploy in preparation for a final single engine burn that would slow the first stage to a velocity of zero before landing on the barge or making a water landing.

Three vessels would be required for the contingency barge landing:

1. Barge/Landing Platform – approximately 300 ft. long and 150 ft. wide
2. Support Vessel – approximately 165 ft. long research vessel
3. Ocean Tug – 120 ft. open water commercial tug

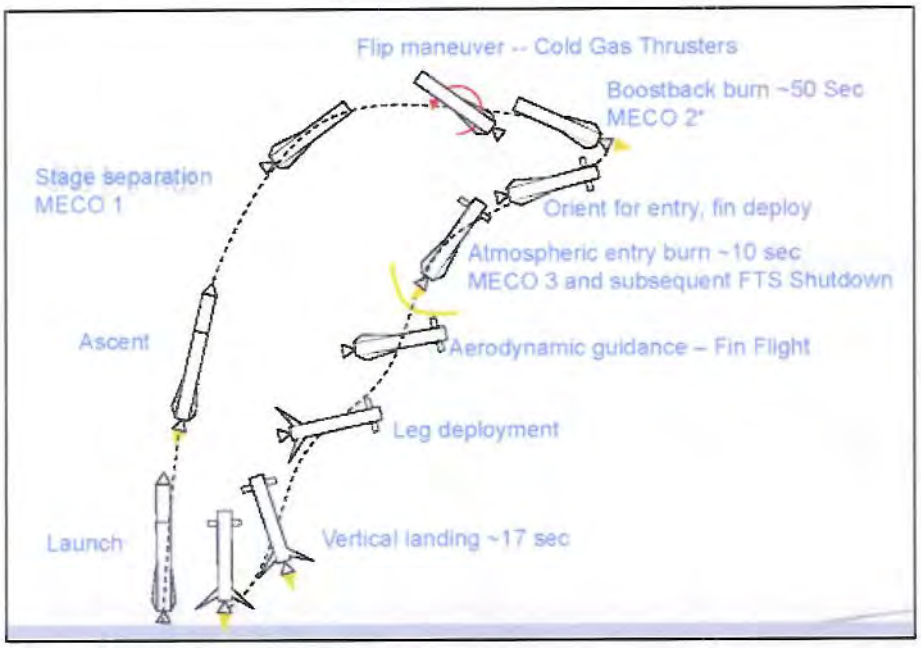

Figure 1. Stages of Boost-Back and Propulsive Landing.

The barge has an operational displacement of 24,000,000 pounds (lb.) and is classified as an American Bureau of Shipping Class-A1 Ocean barge (Figure 3). The barge was modified to accommodate the first stage landing by increasing its width to 150 ft. and installing a dynamic positioning system and a redundant communications and command and control system. The barge has been inspected by the U.S. Coast Guard, and SpaceX has obtained a Certificate of Inspection (COI) for its operation under the service of Research Vessel.

Figure 2. Barge Landing Attempt

The Support Vessel is a 165 ft. long research vessel that is capable of housing the crew, instrumentation and communication equipment, and supporting debris recovery efforts, if necessary. The U.S. Coast Guard will have a representative on this vessel during the operation and a representative in the Launch and Landing Control (LLC) on VAFB to coordinate required clearances and approve access back to the barge after the landing. The tug is a 120 ft. open-water commercial ocean vessel. The primary operation of the tug is to tow the barge into position at the landing site and tow the barge and rocket back to Long Beach Harbor. After landing, the first stage would be secured onto the barge and transported to the Long Beach Harbor for off-loading and transport back to the SLC-4W pad. Hazardous materials would be off-loaded from the first stage after the barge is docked in Long Beach Harbor. The three vessels would be at-sea for approximately 72 hours, including 24 hours to transit to the landing site, 12 hours for pre-launch activation, 12 hours to secure the first stage and equipment for the return trip, and 24 hours to transit back to Long Beach Harbor. Less than 1 hour of transit time would be within 3 nm from shore.

Figure 3. Barge Landing Platform

Two scenarios for a water landing are possible: (1) prior to launch, a decision is made that only a water landing would be attempted and no attempt would be made to land on the barge; and (2) a barge landing is planned, but ocean conditions are unfavorable for a successful landing. In the first scenario, only the support vessel would be used to recover floating debris and to ensure no hazards to navigation are present in the vicinity of the landing site. Neither the barge nor tug would be used. In the second scenario, the barge, tug, and support vessel would be at the landing site in preparation for a barge landing, but if ocean conditions are too rough (the barge can only operate as a landing platform when ocean waves are less than 13 ft. and winds are less than 27 knots) the barge landing attempt would be called off, and a water landing would take place. The support vessel would already be onsite and would proceed with recovering debris following the water landing.

In the event of an unsuccessful landing attempt, the first stage would likely explode upon impact with the barge or water (Figure 4). A system safety analysis was performed by Bastion Services related to first stage recovery operations. This analysis concentrated on safety hazards related to the first stage landing attempt being unsuccessful. The explosive equivalence of the first stage with maximum fuel and oxidizer is 943.4 lb. of trinitrotoluene (TNT). This amount of TNT would be capable of generating a projectile range of 1,250 ft. from the point of impact.

Figure 4. Barge Landing Platform after an Unsuccessful Landing Attempt

Upon impact with the landing barge, the first stage would contain at most 400 gallons of RP-1 (a form of kerosene) on board. If the landing is unsuccessful, most of this fuel would be consumed during the subsequent explosion; residual fuel (estimated to be between 50 and 150 gallons) would be released onto the barge deck at the location of impact. In cases where the first stage booster misses the barge entirely, it would be assumed that 50 to 150 gallons of RP-1 would be released into the ocean. Final volumes of fuel remaining in the first stage upon landing may vary and would be included in the FSDP, but are anticipated to be below the high range estimations.

RP-1 is a Type 1 "Very Light Oil", which are characterized as having low viscosity, low specific gravity and are highly volatile (U.S. Fish and Wildlife Service 1998). Due to its high volatility, RP-1 evaporates quickly when exposed to the air, and would completely dissipate within one to two days after a spill. Clean-up following a spill is usually not possible with spills of very light oil, particularly with such a small quantity of oil (U.S. Fish and Wildlife Service 1998). Therefore, no attempt would be made to boom or recover RP-1 fuel from the ocean.

Please contact me at (805) 605-7924 or Rhys Evans at (805) 606-4198 if you have any questions.

Sincerely,

BEATRICE L. KEPHART
Chief, Installation Management Flight

Attachment:
Description and Assessment of Essential Fish Habitat

Literature Cited:
U.S. Fish and Wildlife Service. 1998. Oil and Nature. New England Field Office. Available at: https://www.fws.gov/contaminants/Documents/OilAndNature.pdf

Description of Essential Fish Habitat

The Magnuson-Stevens Fishery Conservation and Management Act (16 U.S.C. §1801-1882, as amended) requires the delineation and description of Essential Fish Habitat (EFH) by regional fishery management councils, in conjunction with the National Marine Fisheries Service (NMFS), in fishery management plans for all federally managed fish species. Essential Fish Habitat is defined as "those waters and substrate necessary to fish for spawning, breeding, feeding, or growth to maturity." Actions that occur outside of EFH and might affect the habitat must also be taken into account. In addition to EFH designations, areas called Habitat Areas of Particular Concern (HAPCs) are also designated by the regional fishery management councils. Designated HAPCs are discrete subsets of EFH that provide extremely important ecological functions or are especially vulnerable to degradation (50 C.F.R. §§600.805–600.815). Regional fishery management councils may designate a specific habitat area as an HAPC based on one or more of the following reasons (National Marine Fisheries Service 2002):

1. Importance of the ecological function provided by the habitat
2. The extent to which the habitat is sensitive to human-induced environmental degradation
3. Whether, and to what extent, development activities are, or will be, stressing the habitat type
4. Rarity of the habitat type

The contingency landing site offshore of VAFB is within the jurisdiction of the Pacific Fishery Management Council (PFMC). The PFMC has designated EFH and HAPC for Pacific Coast Groundfish (Pacific Fishery Management Council 2011a), Pacific Coast Salmon (Pacific Fishery Management Council 2012), Coastal Pelagic Species (Pacific Fishery Management Council 2011b), and Highly Migratory Species (Pacific Fishery Management Council 2011c). Only EFH and HAPC for Pacific Coast Groundfish and Coastal Pelagic Species are located in waters surrounding the contingency landing site (Pacific Fishery Management Council 2011a, Pacific Fishery Management Council 2011b).

Groundfish species include rockfish (Scorpaenidae), sablefish (*Anoplopoma fimbria*), flatfish (Pleuronectiformes), and Pacific whiting (*Merluccius productus*) that are often (but not exclusively) found on or near the ocean floor or other structures. The EFH for Pacific Groundfish species includes all waters and substrates in areas less than or equal to 3,500 meters (m) (1,914 fathoms [fm]) in depth extending to the mean higher high water level or the upriver extent of saltwater intrusion (to salinity levels of 0.5) (Figure 5). Habitat Areas of Particular Concern designated for groundfish include all waters, substrates, and associated biological communities falling within estuaries, canopy kelp or kelp forests, seagrasses, rocky reefs, and other habitat areas of interest, which includes 13 oil platforms located off the Pacific coast (Pacific Fishery Management Council 2011a) (Figure 5). Rocky reefs are submerged rock outcrops occurring from the intertidal zone to deep water. The rocky reef designation also includes seamounts, which force deep nutrient rich water to the surface. Off the California coast these include, Gumdrop Seamount, Pioneer Seamount, Guide Seamount, Taney Seamount, Davidson Seamount, and San Juan Seamount, as well as Mendocino Ridge, Cordell Bank, and Monterey Canyon.

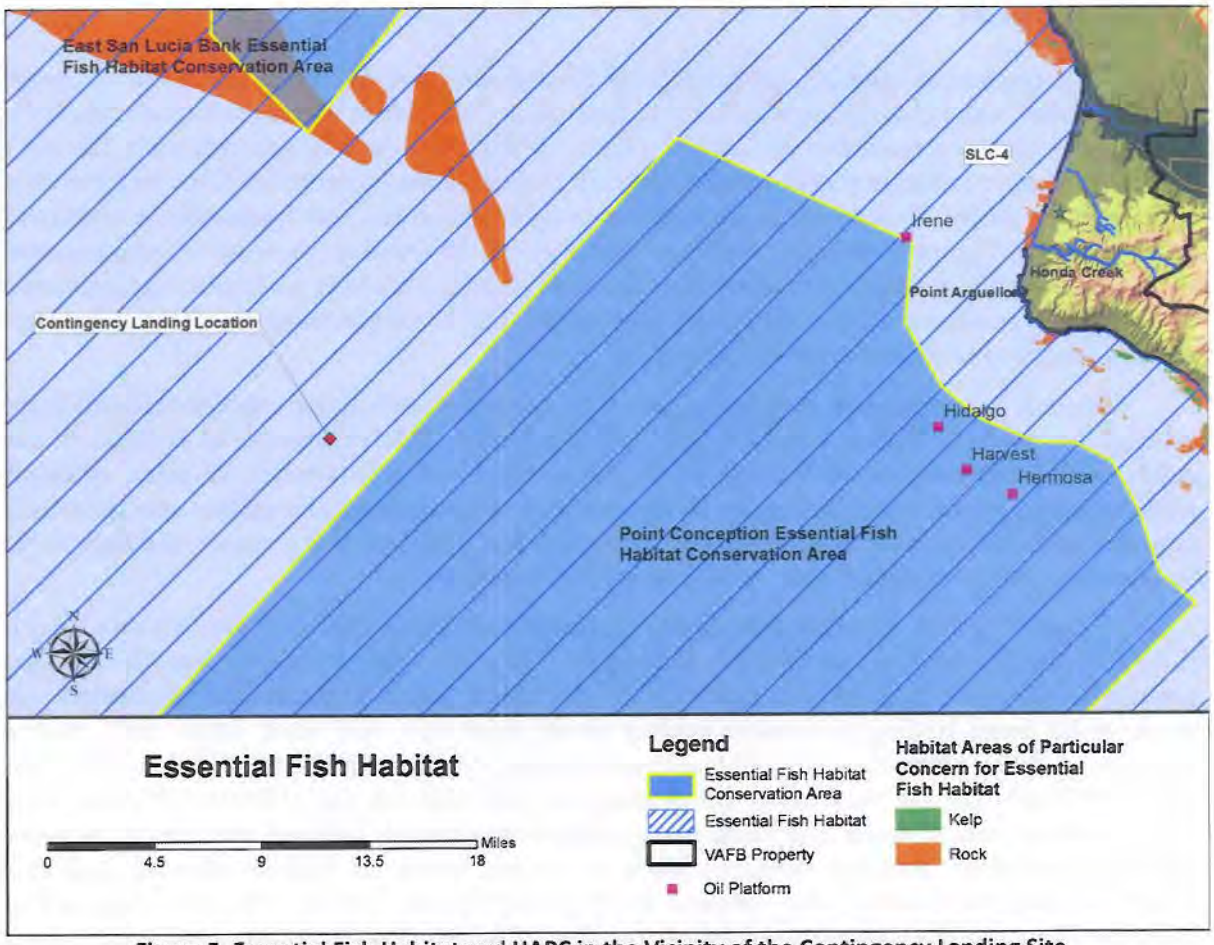

Figure 5. Essential Fish Habitat and HAPC in the Vicinity of the Contingency Landing Site.

Coastal Pelagic Species include finfish such as Pacific sardine (*Sardinops sagax*), Pacific chub mackerel (*Scomber japonicus*), northern anchovy (*Engraulis mordax*), jack mackerel (*Trachurus symmetricus*), and market squid. The EFH for Coastal Pelagic Species includes all marine and estuary waters from the coasts of California, Oregon, and Washington to the limits of the exclusive economic zone (i.e., 200 nautical miles [nm] from shore) and above the thermocline, where sea surface temperatures seasonally range between 50° and 79° Fahrenheit (F) (10° and 26° Celsius [C]) (Pacific Fishery Management Council 2011b). A thermocline is an area in the water column where water temperatures change rapidly with depth. Water temperature is typically colder below the thermocline and warmer above the thermocline. The southern boundary of EFH for Coastal Pelagic Species is the United States and Mexico maritime boundary. The northern boundary of EFH for Coastal Pelagic Species is variable and is defined as the position of the 50°F (10°C) isotherm, which varies seasonally and annually, but even during the warmest times would be located north of the contingency landing site (Pacific Fishery Management Council 2011b). There are no HAPC designated for Coastal Pelagic Species (Pacific Fishery Management Council 2011b).

Analysis of Effects

The contingency landing site is within EFH designated for Pacific Groundfish and Coastal Pelagic Species. The Point Conception EFH Conservation Area, which is restricted to specific types of fishing in order to minimize the adverse effects of fishing, is located approximately 2.5 miles southwest of the contingency landing site (Figure 5). Habitat Areas of Particular Concern have been designated for Pacific Groundfish, as described above. No kelp forests are located in the vicinity of the landing site (Figure 5). Seagrass beds are located along the coastline or within coastal estuaries and are not near the contingency landing site. The nearest rocky substrates are located approximately 10 miles north-northeast of the contingency landing site. The 13 oil platforms are all located at least 25 miles landward of the contingency landing site.

SpaceX has experience performing recovery operations after water and unsuccessful barge landings for previous Falcon 9 First Stage landing attempts. This experience, in addition to the debris catalog that identifies all floating debris, has revealed that approximately 25 pieces of debris remain floating after a water landing or an unsuccessful barge landing. The surface area potentially impacted with debris would be less than 114 acres (0.46 km^2), and the vast majority of debris would be recovered. All other debris sinks to the bottom of the ocean.

These 25 pieces of floating debris are primarily made up of Carbon Over-Pressure Vessels (COPVs), the Liquid Oxygen fill line, and carbon fiber constructed landing legs. SpaceX has performed successful recovery of all of these floating items during previous landing attempts. An unsuccessful barge landing or a water landing would result in a very small debris field, making recovery of debris relatively straightforward and efficient. No floating debris is likely to adversely affect EFH or HAPCs at the landing site or along the California coastline. However, if debris were to wash ashore, which would only occur during high westerly winds coupled with specific seasonal and tidal conditions, attempts would be made to recover the debris without affecting biological resources along the coastline (e.g., western snowy plover nesting habitat). This activity would be monitored by a qualified biologist. All debris recovered offshore would be transported back to Long Beach Harbor.

Since the area that would be impacted by falling debris is very small, the likelihood of significant impacts to EFH for Pacific Groundfish and Coastal Pelagic Species is very low. Denser debris that would not float on the surface is anticipated to sink relatively quickly and is composed of inert materials which would not change the characteristics of bottom substrate EFH. The rate of deposition would vary with the type of debris; however, none is so dense or large that benthic habitat would be degraded. Also, the area that would be impacted by a piece or pieces of sinking debris would be very small. The fuel (RP-1) used in the First Stage is highly volatile and would evaporate quickly when exposed to the air. This type of fuel usually dissipates completely within 1–2 days after a spill. Therefore, clean-up following a spill is usually not necessary, or possible, with spills of very light oil, particularly with such a small quantity that would enter the ocean in the event of a water landing, as discussed above (U.S. Fish and Wildlife Service 1998).

Our determination, for which we request your concurrence, is that the Boost-Back project as described above "may adversely affect Essential Fish Habitat," however only "temporary and no more than minimal effects" are expected.

References

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Pacific Fishery Management Council. (2012). Salmon Fishery Management Plan for Commercial and Recreational Salmon Fisheries off the Coasts of Washington, Oregon, and California, as Revised Through Amendment 17. ed. National Oceanic and Atmospheric Administration, Portland, OR

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DEPARTMENT OF THE AIR FORCE
30TH SPACE WING (AFSPC)

JUN 22 2015

Ms. Beatrice L. Kephart
30 CES/CEI
1028 Iceland Ave
Vandenberg AFB CA 93437-6010

Mr. Will Stelle
NOAA Fisheries Service
Southwest Region
501 West Ocean Blvd, Ste 4200
Long Beach CA 90802-4213

Dear Mr. Stelle

Vandenberg Air Force Base (VAFB) is providing information on the SpaceX Boost-Back and Landing of the Falcon 9 First Stage at a contingency landing site located no less than 31 miles (50 kilometers) offshore of VAFB. The information described below (see attachment) is to assist in the analysis of the effects on marine mammals listed under the Endangered Species Act (ESA) that may occur as a result of the proposed contingency landings.

Under the Proposed Action, SpaceX would land the Falcon 9 First Stage on the pad at SLC-4 West, VAFB. However, one of two contingency landings are also possible: a barge landing occurring approximately 31 miles (50 km) west of VAFB in the Pacific Ocean and a water landing in approximately the same location. Up to six launches and First Stage landings would occur per year, with the first launch scheduled for July 2015. The offshore contingency landing site has the potential to affect seven ESA-listed marine mammal species, five ESA-listed turtles, and two ESA-listed fish species. The purpose of this letter is to briefly describe the proposed activities that have the potential to affect these species, identify the potential stressors associated with the offshore portion of the Proposed Action, and determine whether or not the stressors may affect the ESA-listed species. For all species, we have determined the Proposed Action may affect, but is not likely to adversely affect.

Please contact me at (805) 605-7924 or Rhys Evans at (805) 606-4198 if you have any questions.

Sincerely

BEATRICE L. KEPHART
Chief, Installation Management Flight

Attachment:
Section 7 Consultation Biological Assessment, June 22, 2015

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

August 5, 2015

In reply refer to:
2015/3042

Beatrice L. Kephart
30 CES/CEV
1028 Iceland Avenue
Vandenberg AFB, California 93437-6010

Re: Endangered Species Act Section 7(a) (2) Concurrence Letter, Magnuson-Stevens Fishery Conservation and Management Act Essential Fish Habitat Response, and Marine Mammal Protection Act for the SpaceX Boost-Back and Landing of the Falcon 9 First Stage

Dear Ms. Kephart:

On June 22, 2015, NOAA's National Marine Fisheries Service (NMFS) received your request for a written concurrence that the Vandenberg Air Force Base (VAFB) SpaceX Boost-Back and landing of the Falcon 9 First Stage is not likely to adversely affect (NLAA) species listed as threated or endangered or critical habitats designated under the Endangered Species Act (ESA). On June 26, 2015, NMFS received your amended request for a written concurrence for this same action and the same determination of NLAA species listed as threated or endangered or critical habitats designated under the ESA. This response to your request was prepared by NMFS pursuant to section 7(a)(2) of the ESA, implementing regulations at 50 CFR 402, and agency guidance for preparation of letters of concurrence.

NMFS also reviewed the proposed action for potential effects on essential fish habitat (EFH) designated under the Magnuson-Stevens Fishery Conservation and Management Act (MSA), including conservation measures and any determination you made regarding potential effects of the action in the EFH Assessment. This review was pursuant to section 305(b)(2) of the MSA, implementing regulations at 50 CFR 600.920, and agency guidance on the use of the ESA consultation process to complete the EFH consultation. In this case, NMFS concluded the action would adversely affect EFH and provides an EFH consultation response pursuant to section 305(b)(4)(A) of the MSA for this action. In addition, NMFS provides comments in accordance with the Fish and Wildlife Coordination Act (FWCA).

NMFS also provides preliminary comments concerning potential effects on whales, dolphins, porpoises, seals, and sea lions which are protected under the Marine Mammal Protection Act (MMPA). *See* 16 U.S.C. § 1361 *et seq.* Under the MMPA, it is generally illegal to "take" a marine mammal without prior authorization from NMFS. "Take" is defined as harassing, hunting, capturing, or killing, or attempting to harass, hunt, capture, or kill any marine mammal. Except with respect to military readiness activities and certain scientific research conducted by, or on behalf of, the Federal Government, "harassment" is defined as any act of pursuit, torment, or annoyance which has the potential to injure a marine mammal in the wild, or has the potential to disturb a marine mammal in

the wild by causing disruption of behavioral patterns, including, but not limited to, migration, breathing, nursing, breeding, feeding, or sheltering.

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

Proposed Action and Action Area

SpaceX proposes up to six launches per year of the Falcon 9 rocket. The Falcon 9 is a two-stage rocket designed and manufactured by SpaceX which delivers payloads to space aboard the Dragon spacecraft or inside a composite fairing. Falcon 9 First Stage incorporates 9 Merlin engines and aluminum-lithium alloy tanks containing liquid oxygen and rocket-grade kerosene (RP-1) propellant. The rocket carries landing legs which will land the rocket back on Earth after take-off. Under the proposed action for the Falcon 9 First Stage Boost-back and landing, SpaceX proposes to return the Falcon 9 First Stage to a landing pad at SLC-4 West (W) on VAFB in California for potential reuse. Although, the SLC-4W is the preferred landing location, SpaceX identified the need for contingency landing locations. Originally, SpaceX had identified two contingency landing locations, but a June 26, 2015, letter (see *Consultation History*) indicated that a water landing was no longer under consideration as a contingency landing location which amended the previously submitted letter and information package, dated June 22, 2015. Therefore, the contingency landing location proposed and considered here is landing the First Stage on a barge on the Pacific Ocean at a landing location 31 miles (50 kilometers) offshore of VAFB (Figure 1); nevertheless, NMFS considers the possibility of a water landing resulting from an unsuccessful barge landing in our analysis below. SpaceX would perform a maximum of six contingency landings annually.

After launch of the Falcon 9, the boost-back and landing sequence begins when the First Stage separates from the Falcon 9 and the Merlin engines of the First Stage cut off. After First Stage engine cutoff, rather than dropping the First Stage in the Pacific Ocean, exoatmospheric cold gas thrusters would be triggered to flip the First Stage into position for retrograde burn. Three of the nine First Stage Merlin engines would be restarted to conduct the retrograde burn in order to reduce the velocity of the First Stage in the correct angle to land. Once the First Stage is in position and approaching its landing target, the three engines would be cut off to end the boost-back burn. The First Stage would then perform a controlled descent using atmospheric resistance to slow the stage down and guide it to the landing site.

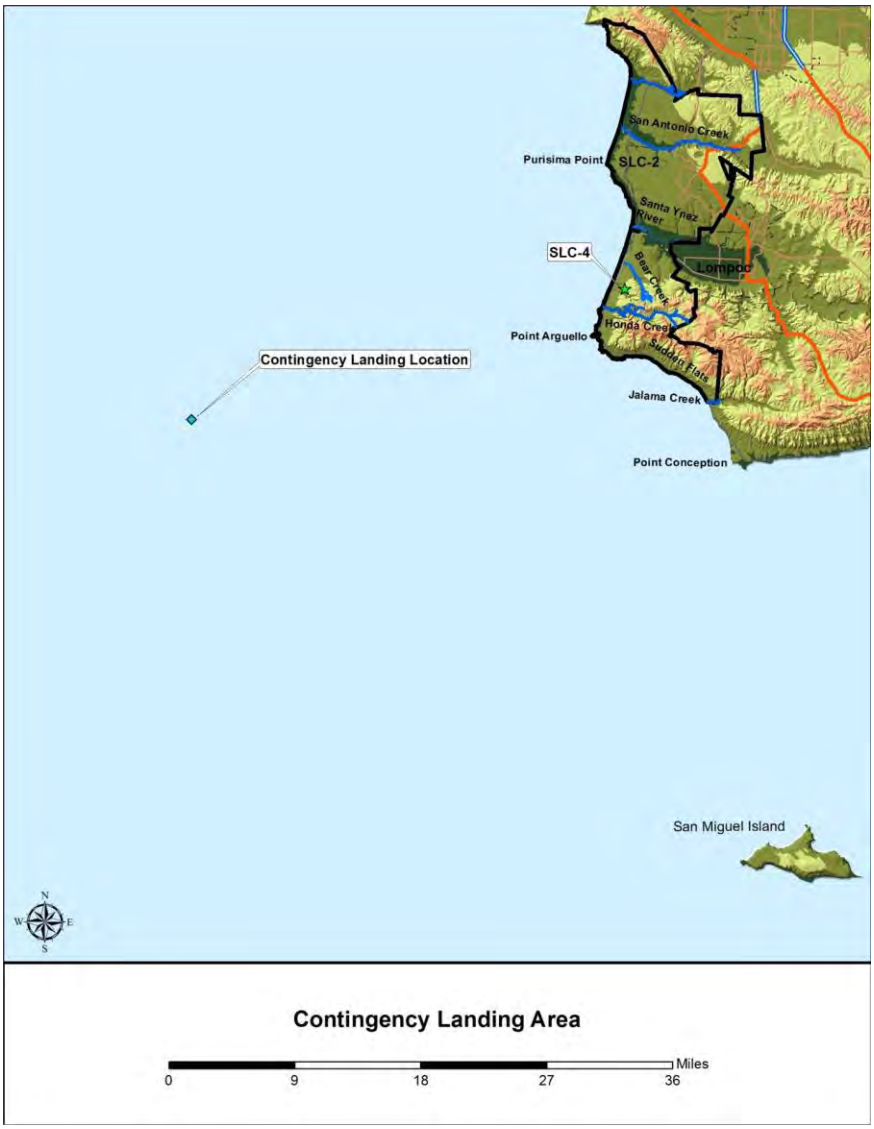


Figure 1. Contingency landing locations for the First Stage at Vandenberg Air Force Base (SLC-4W) and on a barge on the Pacific Ocean located 31 miles (50 kilometers) Vandenberg Air Force Base, California.

Barge Landing

Three vessels would be required to support a barge landing, if a barge landing is required. A barge/landing platform (300 ft. long and 150 ft. wide); a support vessel (165 ft. long research vessel); and an ocean tug (120 ft. long open water commercial tug). The barge was modified to accommodate the First Stage landing by increasing the width of the vessel and installing a dynamic positioning system and a redundant communications and command and control system. The support vessel is capable of housing the crew, instrumentation and communication equipment, and supporting debris recovery efforts. The tug will tow the barge into position at the landing site, after the First Stage lands, it will be secured onto the barge and the tug will tow the barge and the rocket back to Long Beach, California where it will be transported for off-load and transport back to the SLC-4W pad. The three vessels would be at sea for approximately 72 hours, including the 24 hours to transit to the landing site, 12 hours for pre-launch activation, 12 hours to secure the First Stage and

equipment for return trip, and 24 hours to transit back to Long Beach Harbor. The majority of the transit time would occur in Federal waters as it is expected that less than one hour of transit time would be within 3 nm miles from shore in California state waters.

In the event of an unsuccessful barge landing, the First Stage would explode upon impact with the barge. The explosive equivalence with maximum fuel and oxidizer is 503 pounds of trinitrotoluene (TNT) which is capable of a maximum projectile range of 384 m (1,250 ft.) from the point of impact. Approximately 25 pieces of debris are expected to remain floating in the water and expected to impact less than 0.46 km^2 (114 acres), and the majority of debris would be recovered. All other debris is expected to sink. These 25 pieces of debris are primarily made of Carbon Over Pressure Vessels (COPVs), the LOX fill line, and carbon fiber constructed legs. During previous landing attempts in other locations, SpaceX has performed successful debris recovery. All of the recovered debris would be transported back to Long Beach Harbor for proper disposal. It is also expected that most of the fuel (estimated 50-150 gallons) would be released onto the barge deck at the location of impact. In cases where the First Stage booster misses the barge entirely, it would be assumed that the 50-150 gallons of fuel would be released into the ocean.

Agency's Effects Determination

VAFB has determined that the Project is not likely to adversely affect the threatened: Guadalupe fur seal (*Arctocephalus townsendi*), green sea turtle (*Chelonia mydas*), olive Ridley sea turtle (*Lepidochelys olivacea*)*;* and the endangered: blue whale (*Balaenoptera musculus*), fin whale (*B. physalus*), gray whale (*Eschrichtius robustus*; Western North Pacific stock), humpback whale (*Megaptera novaeangliae*), sei whale (*B. borealis*), sperm whale (*Physeter macrocephalus*), hawksbill sea turtle (*Eretmochelys imbricata*), loggerhead sea turtle (*Caretta caretta*), leatherback sea turtle (*Dermochelys coriacea*), steelhead (*Oncorhynchus mykiss*), and scalloped hammerhead shark (*Sphyrna lewini*).

The Agency did not make an initial determination for the endangered green sturgeon *(Acipenser medirostris)*, but after further consultation with NMFS, the Agency determined that a similar evaluation and determination of not likely to adversely affect would pertain to the green sturgeon as it did for the other two ESA-listed fish species.

Their reasoning for the above determinations include the low density of animals potentially present in the proposed project area, the low likelihood that the proposed project's impacts at the water's surface would reach a submerged animal, and the short duration of the proposed activity.

Consultation History

During a telephone call to discuss another project on March 27, 2015, VAFB staff indicated to NMFS staff that the SpaceX proposed project may be forthcoming, but no further details were given at that time. NMFS did request some preliminary information regarding the proposed potential project, such as project description and any preliminary analyses that had been conducted to estimate take of marine mammals. On April 14, 2015, VAFB staff indicated that they were still assembling the information NMFS requested during the March 17, 2015, call. On April 16, 2015, VAFB staff provided to NMFS, via email, a Description of the Proposed Action and Alternatives and a marine mammal direct strike analysis, debris catalog matrix, a memo from Smultea Sciences supporting the "0.5 take" approach (*i.e.,* if take estimates are <0.5, no permit is necessary under the Marine Mammal Protection Act), and a Federal Register Notice (80 FR 13264; March 13, 2015,) where the <0.5 takes approach was presented. VAFB staff also had a call with NMFS staff on April 20, 2015,

to discuss potential impacts to sea turtles and EFH and on April 27, 2015, to discuss the information provided with regard to potential takes of marine mammals. During the two April 2015 calls, staff from VAFB introduced the proposed project, but at the time very little was known and it was thought to be a one-time test. The initial consultation request was received by NMFS from VAFB on June 22, 2015, and a modification to that initial consultation request was received by NMFS from VAFB on June 16, 2015. NMFS deemed the information complete, but on July 7, 2015, NMFS left a voicemail and emailed VAFB staff requesting clarification regarding the calculations for the acoustic zones of influence and if VAFB agreed that the green sturgeon should be included in the consultation. On July 8, 2015, VAFB responded via email that information on the acoustic zones of influence would be forthcoming and that they agreed to include the green sturgeon in the consultation and on July 9, 2015, staff from NMFS, VAFB, and ManTech discussed the acoustic impacts analysis relative to potential impacts to marine mammals. Also during the July 9, 2015, phone call, ManTech staff indicated that their acoustic analyses would be included in an Incidental Harassment Authorization (IHA) application that SpaceX intended to submit to NMFS, but it is not known when, or if, the IHA application will be submitted and what the nature of the take request might be under the Marine Mammal Protection Act (MMPA). On July 20, 2015, NMFS staff requested clarification on the likelihood of an unsuccessful barge landing where the Flacon 9 first stage would miss the barge and hit the water and VAFB staff provided a response that same day.

ENDANGERED SPECIES ACT

Effects of the Action

Under the ESA, "effects of the action" means the direct and indirect effects of an action on the listed species or critical habitat, together with the effects of other activities that are interrelated or interdependent with that action (50 CFR 402.02). The applicable standard to find that a proposed action is not likely to adversely affect listed species or critical habitat is that all of the effects of the action are expected to be discountable, insignificant, or completely beneficial. Beneficial effects are contemporaneous positive effects without any adverse effects to the species or critical habitat. Insignificant effects relate to the size of the impact and should never reach the scale where take occurs. Discountable effects are those extremely unlikely to occur.

The proposed contingency actions include three potential impacts that may cause adverse effects on ESA-listed marine mammals, sea turtles, and fish species that occur in the vicinity of the contingency landing site. These include potential debris strike, underwater acoustic impacts, and interactions with expended materials.

Debris Strike

The following ESA-listed marine mammals were considered: Guadalupe fur seal (*Arctocephalus townsendi*), blue whale (*Balaenoptera musculus*), fin whale (*B. physalus*), gray whale (*Eschrichtius robustus*; Western North Pacific stock), humpback whale (*Megaptera novaeangliae*), sei whale (*B. borealis*), and the sperm whale (*Physeter macrocephalus*). Although the resulting explosion could reach a maximum impact area of 0.46 km2 (114 acres), based on engineering analysis from SpaceX's Texas Rocket Development Facility, the debris would likely impact .000706 km^2 of the 0.46 km^2 impact area. Using the United States Navy's probability of impact analysis (U.S. Department of the Navy 2014) and assuming a dynamic scenario, in which the width of the footprint is enhanced by a factor of 5 to reflect momentum created by the explosion, the probability of impact with a single marine mammal was calculated. SpaceX proposes to conduct six contingency offshore landings per year, which could result in 0-6 First Stage explosions and we therefore conservatively use the maximum number of six for our calculations. Based on the estimated marine mammal density per

km^2 and assuming that animals are at the surface at all times, the estimated number of impacts per year for any ESA-listed marine mammal is <0.001. We conclude that it would be extremely unlikely that any of the seven ESA-listed marine mammals would be struck by debris as a result of the proposed Falcon 9 First Stage landings. As a result, the potential debris strike from the First Stage explosion may affect, but is not likely to adversely affect the Guadalupe fur seal, blue whale, fin whale, gray whale (Western North Pacific stock), humpback whale, sei whale, and sperm whale.

The probability of impact with a sea turtle was estimated using the same approach presented above for marine mammals, but the calculations were limited by the lack of similar density data for the following ESA-listed sea turtles: green sea turtle (*Chelonia mydas*), loggerhead sea turtle (*Caretta caretta*), olive Ridley sea turtle (*Lepidochelys olivacea*), and hawksbill sea turtle (*Eretmochelys imbricata*). However, there is density information on the leatherback sea turtle (*Dermochelys coriacea*) and thus, if we use the leatherback sea turtle density information as a surrogate for the other sea turtles that could be observed within the impact area (presence is expected to be rarer for the other 4 sea turtles because of their known distribution in the area), the estimated probability of debris impact with a leatherback sea turtle is 0.0003. This is then calculated to an estimated annual number of takes of 0.0019 leatherback sea turtles (i.e., the probability of impact multiplied by the leatherback sea turtle density expected in that area). We know that the other 4 ESA-listed sea turtles likely to be in the impact area is less than what is expected for a leatherback sea turtle as calculated above, therefore, the estimated annual number of takes for the green sea turtle, loggerhead sea turtle, olive Ridley sea turtle, and hawksbill sea turtle is <0.0019 for each species. We conclude that it would be extremely unlikely that any of the ESA-listed sea turtles would be struck by debris as a result of the proposed Falcon 9 First Stage landings. As a result, the potential debris strike from the First Stage explosion may affect, but is not likely to adversely affect the green sea turtle, loggerhead sea turtle, olive Ridley sea turtle, hawksbill sea turtle, and leatherback sea turtle.

Sufficient density data are not available to conduct a debris strike analysis for ESA-listed fish species in the manner conducted above for marine mammals and sea turtles. However, it is assumed that ESA-listed fish species likely to be in the area would be rare because of their known distribution in the area and likely swimming below the surface at all times. Should debris hit the water, it is expected that the initial impact at the water's surface or even slightly below the surface, would absorb much of the energy from that impact. If they were present, ESA-listed fish would be expected to be below this initial area of impact, and therefore unaffected by the debris. Although the initial consultation only analyzed the potential impact to steelhead (*Oncorhynchus mykiss*) and scalloped hammerhead shark (*Sphyrna lewini*) because of the higher likelihood that they may inhabit the impact area, NMFS and VAFB assumed (see *Consultation History*) that a similar evaluation and analysis would pertain to the green sturgeon *(Acipenser medirostris),* although the landing location is slightly south of its primary range. As a result of the potential debris strike as a result of First Stage explosion may affect, but is not likely to adversely affect the scalloped hammerhead shark, steelhead, and green sturgeon.

Underwater Acoustic Impacts

Impulse sounds may include a sonic boom from the First Stage boost-back or an explosion of the First Stage landing from an unsuccessful barge landing. Non-impulse noise would include engine noise from the First Stage landing and vessel noise from the barge, tug, and support vessel. NOAA is developing comprehensive guidance on sound characteristics likely to cause injury and behavioral disruption in the context of the MMPA, ESA, and other statutes. Until formal guidance is available, NMFS uses conservative thresholds of received sound pressure levels from broad band sounds that may cause behavioral disturbance and injury. These conservative thresholds are applied in both MMPA permits and ESA Section 7 consultations for marine mammals to evaluate the potential for

sound effects. The criterion levels specified here are specific to the levels of harassment as defined under the MMPA. Level A criterion for in-water PTS (injury), excluding tactical sonar and explosives, is 190 $dB_{Root\ Mean\ Square\ (rms)}$ re 1 µPa for pinnipeds and 180 dB_{rms} re 1 µPa. Level B criterion for in-water for behavioral disruption for impulsive noise, is 160 dB_{rms} re 1 µPa; Level B criterion for in-water for behavioral disruption for non-pulse noise is 120 dB_{rms} re 1 µPa. There is no threshold established for Level A criterion for in-air PTS (injury), but for the Level B criterion in-air for harbor seals it is 90 dB_{rms} and for all other pinniped species, it is 80 dB_{rms}. We evaluated the proposed project activities using the above acoustic thresholds. In the ESA context, these thresholds are informative as the thresholds at which we might expect either behavioral changes or physical injury to an animal to occur, but the actual anticipated effects would be the result of the specific circumstances of the action (as further explained below).

Sonic Boom

It is likely that any noise associated with the sonic boom would transmit from the air to water and propagate some distance in the water column. All of the boom pressure signals measured in Sohn *et al.* (2000) experiment decayed to ambient levels in all frequency bands by 40-50 m (131-164 ft.). A sonic boom at the surface of 2 pounds per square foot (similar to the anticipated sonic boom from the proposed SpaceX activities) decayed to approximately 152 dB re 1µPa at a depth of 7 m (23 ft.). By 22 m (72 ft.), the received levels were approximately 140 dB re 1 µPa and at 37 m (121 ft.), it was equal to ambient noise levels. All of these sound pressure levels are below the current NMFS threshold for potential permanent injury (190 dB_{rms} re 1 µPa sound pressure level for pinnipeds and 180 dB_{rms} re 1 µPa sound pressure level for cetaceans) and potential behavioral change or temporary injury (160 dB_{rms} re 1 µPa sound pressure level). The information provided to NMFS did not indicate the point at which underwater sound pressure levels would equal or exceed 160dB_{rms} re 1 µPa, but we estimate this would likely occur at less than 7 m which could be at or near the surface level of the water based on the decay rate provided above at a depth of 7m. Based on the estimated sound levels, the frequency with which the sonic booms may occur over the course of a year and the relative infrequency with which ESA-listed mammals and turtles may be in the immediate vicinity during those times, we conclude that sonic booms associated with contingency landing actions may affect, but are not likely to adversely affect the ESA-listed marine mammals or sea turtles.

The onset of physical injury to fish would be expected if the peak levels exceed 206 dB re 1 µPa (Stadler and Woodbury 2009). As a result, the sonic boom associated with the contingency landing would be less than an explosion on the barge (blast injury and barotrauma is measured following exposure to an explosion) and would be less than what is estimated above at the water's surface generated by the Falcon 9 First Stage during the contingency barge landing, and therefore may affect, but is not likely to adversely affect the scalloped hammerhead shark, steelhead, and green sturgeon.

Explosion

Noise resulting from an unsuccessful barge landing could introduce impulse sound into the ocean or near the water's surface. The direct sound from the explosion would last less than a second. These sounds would be in the audible range of most marine mammals, even if the duration is expected to be very short. The six landing attempts would occur each year and likely dispersed over the course of that year. The spacing of the landing attempts would likely reduce the potential for long-term auditory masking. However, because of its intensity, the direct sound from an explosion could cause behavioral or physiological effects. Depending on the amount of fuel left, the intensity of the explosion will likely vary, but we considered the worst-case scenario, the largest possible amount of fuel left that could create the largest explosion. If an estimated 8% loss of energy is included as a result of the explosion occurring on the surface of the water, at a depth of 10 m (33 ft.), the estimated

received level is 249 dB re 1 µPa and at a depth of 100 m (328 ft.), the estimated received level is 230 dB re 1 µPa which is the sound pressure level identified in Southall *et al.* (2007) for the onset of PTS in cetaceans to "discrete" noise events (either single or multiple exposures within a 24-h period). The onset of a temporary threshold shift (TTS) has been defined as being a temporary elevation of a hearing threshold by 6 dB (*e.g.,* Schlundt *et al.* 2000), although smaller threshold shifts have been demonstrated to be statistically significant with a sufficient number of samples (*e.g.,* Kastak *et al.* 1999; Finneran *et al.* 2005a). If we use the TTS threshold for the most sensitive ESA-listed marine mammal species that could be in the proposed project area (Guadalupe fur seal), the threshold for onset of TTS is 212 dB re 1 µPa (Southall *et al.* 2007), which would occur within a 2,000 m (6,562 ft.) radius, if an unsuccessful barge landing occurred in the water, which is extremely unlikely to occur (see below). When working with explosive sound impulses it is more appropriate to use the peak sound pressure level and the 180 dB and 160 dB thresholds are root mean[2] values that are not typically applied to explosions[1].

However, if an explosion occurs as a result of an unsuccessful barge landing, SpaceX expects it would be on the barge and not directly in the water. VAFB provided a response from SpaceX who indicated[2] that they were 100% successful at hitting the barge in two previous attempts when the barge was in place for the landing attempt. Therefore, we will use the analysis provided above as a starting point, because we expect that significantly less energy from the explosion would transmit into the water if an explosion occurs on the barge and the zone of influence would be much less than what was calculated above. An explosion on the barge would cause an in-air blast that would propagate in all directions, including the surface of the water, but the barge itself would act as a barrier and would be expected to minimize the amount of energy directed into the ocean. It is expected that the in-water sound levels would be below the onset of PTS for any marine mammal species or the current NMFS threshold for Level A (in-water of 190 dB_{rms} re 1 µPa sound pressure level for pinnipeds and 180 dB_{rms} re 1 µPa sound pressure level for cetaceans), even though these thresholds are not typically applied to explosive activities. Based on the information provided for the ESA consultation, it seems unlikely that any explosion, should it occur, would have a zone of influence (ZOI) surrounding the barge area that would extend much farther beyond that area in the vicinity of the barge's footprint that would correspond to the current NMFS threshold for potential behavioral change or temporary injury (in-water160 dB_{rms} re 1 µPa sound pressure level or in-air for harbor seals it is 90 dB_{rms} and for all other pinniped species, it is 80 dB_{rms}) based on the source level of the explosion, the distance the sound would travel, and considering that the barge would act as a barrier to any sound produced. Disruption and disturbance of any marine mammal may occur, if they can detect the explosive event, but any disruption or disturbance caused by an explosion would be temporary (*e.g.,* an explosion is expected to last less than a second). Using the same analysis for the probability of debris strike above, the approach indicates that the probability of each ESA-listed marine mammal species occurring with the impact zone at the water's surface is 0.002 for cetaceans and 0.09 for Guadalupe fur seals. The expected behavioral response by an animal exposed to the sound produced by an explosion could be relocation to an area away from the barge, disruption in feeding, or a change in dive pattern or respiration rate. Although there is a chance that a marine mammal could be present in the acoustic ZOI area, any behavioral response is not expected to reduce the fitness of that individual animal because any marine mammal in the ZOI area is already transiting or if feeding, is doing so opportunistically (*i.e.,* this is not a known high density feeding area for marine mammals). As described above, the barge is expected to reduce the one second, one time acoustic impact of an explosion during unsuccessful barge landing; the resultant acoustic impact is

[1] http://www.westcoast.fisheries.noaa.gov/protected_species/marine_mammals/threshold_guidance.html)

[2] Email from Darryl York (VAFB) on behalf of SpaceX to Monica DeAngelis (NMFS) dated July 20, 2015

not expected to disrupt the behavior pattern in ways that reduce the fitness of the Guadalupe fur seal, blue whale, fin whale, gray whale (Western North Pacific stock), humpback whale, sei whale, and sperm whale individuals and is therefore an insignificant effect.

Since the onset for injury from sound pressure levels are evaluated in the same way for sea turtles as they are for marine mammals, a sea turtle would be expected to experience physiological impacts if it is within the 2000 m (6,562 ft.) of an explosion that occurs at the water's surface. Beyond 2000 m (6,562 ft.), it is unlikely that physiological impacts would occur, but possible behavioral responses could include relocation to an area away from the barge, disruption in feeding, or a change in dive pattern or respiration rate. Although there is a very small chance that a sea turtle could be present, any behavioral response is not expected to reduce the fitness of that individual animal because any sea turtle in the area is already transiting or if feeding, is doing so opportunistically (*i.e.,* this is not a known high density feeding area for sea turtles). Similar to marine mammals, an explosion on the barge resulting from an unsuccessful landing would result in significantly less acoustic energy transmitting into the water and the zone of influence would be less (< 0.0044). As described above, the barge is expected to reduce the one second, one time acoustic impact of an explosion during unsuccessful barge landing; the resultant acoustic impact is not expected to disrupt the behavior patterns in ways that reduce the fitness of green sea turtle, loggerhead sea turtle, olive Ridley sea turtle, hawksbill sea turtle, and leatherback sea turtle individuals and is an insignificant effect.

A conservative estimate of 10% mortality was estimated for fish with swim bladders potentially occurring in the contingency landing location would be 214 m (702 ft.) (for a 1 pound fish). The estimated range in which injury could occur to fish with swim bladders (> 2 grams) would be 815 m (2,674 ft.). Therefore, the area of potential impact to fish species with swim bladders is an approximately 815 m (2,674 ft.) radial area around the surface of the water. The density of the fish killed by a surface water explosion would be density dependent and highly variable. As indicated above, NMFS does not expect that the ESA-listed fish species commonly occur in the area. In addition, an explosion on the barge resulting from an unsuccessful landing would result in significantly less acoustic energy transmitting into the water and the zone of influence would be less, as discussed above. Behavioral disturbance thresholds for fish are lower than for mammals (150db) but similar to our assessment for mammals and turtles we do not expect and behavioral disruption, if it even occurs, to affect fitness of the exposed fish. As a result, impacts to ESA-listed fish, if present, from an explosion on the barge would be less than what is estimated above at the water's surface generated by the Falcon 9 First Stage during the contingency barge landing, and therefore may affect, but is not likely to adversely affect the scalloped hammerhead shark, steelhead, and green sturgeon.

Landing Noise

The Falcon 9 First Stage will generate landing noise up to 110 dB (well below the ESA and MMPA thresholds) for a short duration (minutes). Should a marine mammal be at the water's surface at the time of the landing, the sound could elicit a response such as an alert, avoidance, or other behavioral reactions such as diving and moving away from the source, but any response is expected to be temporary, if it occurs at all. The landing noise is not expected to have an effect on submerged animals or those that spend a considerable amount of time submerged, such as large whales or sea turtles. Disturbance to landing noise would be unlikely to cause long-term impacts to marine mammals. As a result, landing noise generated by the Falcon 9 First Stage during the contingency landings may affect, but is not likely to adversely affect the Guadalupe fur seal, blue whale, fin whale, gray whale (Western North Pacific stock), humpback whale, sei whale, sperm whale, green sea turtle, loggerhead sea turtle, olive Ridley sea turtle, hawksbill sea turtle, and leatherback sea turtle.

Fish at or near the surface of the water would potentially experience behavioral disturbance, but in the unlikely event that a fish is near enough to the water's surface at the time of the landing to detect the noise, any response is expected to be temporary due to the short duration of the landing noise and the sound levels transmitted into the water would be far below injury or disturbance levels. As a result, landing noise generated by the Falcon 9 First Stage during the contingency landings may affect, but is not likely to adversely affect the scalloped hammerhead shark, steelhead, and green sturgeon.

Vessel Noise

Vessel noise does have the potential to disturb marine mammals by eliciting an alert, avoidance, or other behavioral reactions such as diving and moving away from the source. Marine mammals and sea turtles in the proposed zone of influence may be exposed to project-related vessels and vessel noise. However, it may be difficult for the animals to discern vessel noise associated with the proposed activities as additional to that which is already present due to research, ecotourism, commercial or private vessels, or government activities. As a result, vessel noise generated by the support vessels required to support the contingency landing actions may affect, but are not likely to adversely affect the Guadalupe fur seal, blue whale, fin whale, gray whale (Western North Pacific stock), humpback whale, sei whale, sperm whale, and green sea turtle, loggerhead sea turtle, olive Ridley sea turtle, hawksbill sea turtle, and leatherback sea turtle.

Vessel noise has the potential to create in-water sound that could disturb ESA-listed fish species, which could result in behavioral (*e.g.,* avoidance) or physiological responses (*e.g.,* stress, increased heart rate). While vessel movements have the potential to expose ESA-listed fish species occupying the water column to noise and general disturbance, potentially resulting in short-term behavioral or physiological responses, such responses would not be expected to compromise the health, condition, or fitness of individual fish because the impacts from vessel noise would be temporary, infrequent, and localized. As a result, vessel noise generated by the support vessels required to support the contingency landing actions may affect, but are not likely to adversely affect the scalloped hammerhead shark, steelhead, and green sturgeon.

Expended Materials and Fluids

Debris

Approximately 25 pieces of debris remain floating after a water landing or an unsuccessful barge landing with a potentially impacted surface area of less than 0.46 km^2 (114 acres), and the vast majority of debris would be recovered. All other debris is expected to sink to the bottom of the ocean. Depending on the type of materials involved, amount of debris, density, and other factors, the potential risks posed by the debris that was not collected are: degradation of water quality, substrate or habitat, which in turn would affect the listed species which use them. Since the area that would be impacted by falling debris is very small, the likelihood of adverse effects to ESA-listed marine mammals, fish, or turtles is very low. Furthermore, denser debris that would not float on the surface is anticipated to sink relatively quickly and is composed of inert materials which, by nature of their composition, would not affect water quality or bottom substrate or benthic habitat potentially used by ESA-listed marine mammals and sea turtles. The rate of deposition would vary with the type of debris; however, none of the debris is so dense or large that benthic habitat would be degraded. As a result, debris from an unsuccessful barge landing or a water landing that enters the ocean environment approximately 31 miles (50 km) from shore may affect, but is not likely adversely affect the Guadalupe fur seal, blue whale, fin whale, gray whale (Western North Pacific stock), humpback whale, sei whale, sperm whale, green sea turtle, loggerhead sea turtle, olive Ridley sea turtle,

hawksbill sea turtle, and leatherback sea turtle, scalloped hammerhead shark, steelhead, and green sturgeon.

Rocket Propellant

In the event of an unsuccessful landing attempt, the First Stage would explode upon impact with the barge or water. At most, the First Stage would contain 400 gallons of rocket propellant (RP-1 or "fuel") on board. In the event of an unsuccessful barge landing, most of this fuel would be consumed during the subsequent explosion. Residual fuel (estimated to be between 50 and 150 gallons) would be released into the ocean. The fuel used by the First Stage, RP-1, is a Type 1 "Very Light Oil", which is characterized as having low viscosity, low specific gravity, and are highly volatile (U.S. Fish and Wildlife Service 1998). Due to its high volatility, RP-1 evaporates quickly when exposed to the air, and would completely dissipate within one to two days after a spill in the water. Clean-up following a spill of very light oil is usually not necessary or not possible, particularly with such a small quantity of oil that would enter the ocean in the event of a water landing (U.S. Fish and Wildlife Service 1998). Therefore, no attempt would be made to boom or recover RP-1 fuel from the ocean. RP-1 on the water's surface would move with the water flow, being transported due to the velocities in the surface layer. As such, the prevailing current, tide, and wind patterns offshore of VAFB would tend to move the RP-1 in a clockwise pattern in a predominately south-southeast direction and is unlikely to reach any shoreline or any nearshore habitats (*e.g.,* kelp beds). The ESA-listed fish species, steelhead, green sturgeon, and scalloped hammerhead shark, are typically below the surface and would not be expected to interact with surface of the water frequently, making them unlikely to be exposed to RP-1 on the ocean surface during the one to two day period during which it would dissipate. In addition, the probability of steelhead, scalloped hammerhead sharks, or green sturgeon being present at contingency landing location during a landing event would be very low, thus further reducing likelihood of exposure. "Very light oil" is not known to cause injury or harm to animals that are directly exposed to it and the spilled fuel from an unsuccessful barge landing or a water landing that enters the ocean environment approximately 31 miles (50 km) from shore is expected to evaporate quickly when exposed to the air, and would completely dissipate within one to two days after a spill in the water, so it may affect, but is not likely to adversely affect Guadalupe fur seal, blue whale, fin whale, gray whale (Western North Pacific stock), humpback whale, sei whale, sperm whale, green sea turtle, loggerhead sea turtle, olive Ridley sea turtle, hawksbill sea turtle, and leatherback sea turtle, scalloped hammerhead shark, steelhead, and green sturgeon.

Conclusion

Based on this analysis, NMFS concurs with VAFB and SpaceX that the proposed action is not likely to adversely affect the subject listed species. Critical habitat has not been designated or proposed for the marine mammal and the green sea turtle, loggerhead sea turtle, olive Ridley sea turtle, hawksbill sea turtle; therefore, none was analyzed. Critical habitat for the leatherback sea turtle is designated in the action area. Prey is an essential feature of leatherback critical habitat and the preferred prey of leatherbacks off the California coast is jellyfish, with other gelatinous prey, such as salps (a pelagic tunicate), considered of lesser importance (77 FR 4170), but there is no indication that the proposed project activities could impact prey or the critical habitat of leatherback sea turtles. As a result, NMFS concludes that the proposed action is not likely to adversely affect critical habitat for the leatherback sea turtle. Critical habitat for steelhead does exist on the mainland within the VAFB, but the proposed project's action area will not overlap with the designated critical habitat and therefore, NMFS concurs that the proposed action is not likely to adversely affect steelhead designated critical habitat.

Reinitiation of Consultation

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

MAGNUSON-STEVENS FISHERY CONSERVATION AND MANAGEMENT ACT

Under the MSA, this consultation is intended to promote the protection, conservation and enhancement of EFH as necessary to support sustainable fisheries and the managed species' contribution to a healthy ecosystem. For the purposes of the MSA, EFH means "those waters and substrate necessary to fish for spawning, breeding, feeding, or growth to maturity", and includes the associated physical, chemical, and biological properties that are used by fish (50 CFR 600.10), and "adverse effect" means any impact which reduces either the quality or quantity of EFH (50 CFR 600.910(a)). Adverse effects may include direct, indirect, site-specific or habitat-wide impacts, including individual, cumulative, or synergistic consequences of actions.

Action Area

The proposed project occurs within EFH for various federally managed fish species within the Pacific Coast Groundfish, Coastal Pelagic Species, and Highly Migratory Species Fishery Management Plans (FMPs). Kelp, rocky reef, and seagrass habitats are designated as habitat areas of particular concern (HAPC) for various federally managed fish species within the Pacific Coast Groundfish FMP. HAPC are described in the regulations as subsets of EFH which are rare, particularly susceptible to human-induced degradation, especially ecologically important, or located in an environmentally stressed area. Designated HAPC are not afforded any additional regulatory protection under MSA; however, federal projects with potential adverse impacts to HAPC will be more carefully scrutinized during the consultation process.

The nearest kelp habitat is located offshore of the land-based SLC-4 site, while the nearest rocky reef habitat is located approximately 10 miles north-northeast of the ocean-based contingency landing site. Seagrass beds are located along the coastline or within coastal estuaries. As noted in the EFH Assessment, strong westerly winds, combined with specific currents and/or tidal conditions, could transport debris from an unsuccessful barge landing as far as the shoreline. However, given the distance to these HAPCs, the successful recovery of floating debris on previous landing attempts, and the specific conditions required to transport the debris long distances, NMFS does not expect HAPCs to be impacted by the proposed project. Please note that oil platforms were ultimately not identified as HAPC under the Pacific Coast Groundfish FMP. The proposed project is also located approximately 2.5 miles and 12.6 miles from the Point Conception and East San Lucia Bank EFH Conservation Areas, respectively.

Effects of the Action

The adverse effects of an unsuccessful barge landing of the Falcon 9 First Stage may include the discharge of fuel. Adverse effects to EFH species and their prey associated with petroleum-based contaminants can range from acute toxicity at high levels of exposure to chronic sublethal toxicity

(Khan et al 2007; Seuront 2011). However, the first stage booster uses RP-1, characterized as a "Very Light Oil" that has a low viscosity, low specific gravity and is highly volatile. In addition, the anticipated amount of residual fuel during an unsuccessful landing attempt would be limited (i.e., 50-150 gallons) and would most likely be released onto the barge deck upon impact. In the event the first stage booster misses the barge entirely and the fuel is released into the ocean, the RP-1 would be expected to evaporate quickly and would completely dissipate within one to two days after a spill. Clean-up of very light oil spills are usually not possible, especially with such small quantities. Given the small quantity and composition of the fuel that may be released, any adverse impacts to EFH would be minimal.

An unsuccessful barge landing would result in a projectile range of up to 1,250 feet. However, similar to our determination in the above ESA effects analysis, NMFS concludes that a direct strike to a federally managed fish species from debris, though not impossible, is highly unlikely given the relatively small impact area and amount of debris. Of greater concern would be the more likely occurrence of unrecoverable debris sinking to the bottom of the ocean. The potential area of impact consists primarily of sandy substrate, which is not identified as a particularly sensitive habitat for federally managed fish species. However, there are a number of species managed under the Pacific Coast Groundfish FMP that utilize offshore unconsolidated benthic habitats for at least part of their life cycle (e.g., various rockfish, flatfish, and sharks/skates) for functions such as foraging or refuge. In fact, in the Southern California Bight, approximately 40% of the fish species and 50% of the families are present in soft-bottom areas of the open coast (Cross and Allen 1993), and introducing foreign material could reduce the functionality of those habitats. Marine debris, which can consist of a wide variety of man-made materials, is a growing concern due to the increasing number of species for which negative interactions with debris have been demonstrated (Smith and Edgar 2014). In addition, debris may settle in areas off the west coast that already have high concentrations, such as deep water habitat (550-1280 m) and waters south of 36°N (Keller et al 2010). Although the debris associated with the proposed project is described as "inert", it could still result in adverse impacts. For instance, marine debris may be ingested by, or entangle marine organisms and alter the benthic invertebrate community (Katsanevakis et al 2007). Marine debris can also become snagged on and/or damage sensitive habitats, such as reefs, though this would only occur under a specific set of conditions as noted in the EFH action area section. In conclusion, while an unsuccessful Falcon 9 First stage barge landing may not substantially contribute to marine debris on an individual basis, a number of these incidents over time could result in the cumulative addition of marine debris to the seafloor that would adversely affect EFH.

EFH Conservation Recommendations

Based upon the above effects analysis, NMFS has determined that the proposed action would adversely affect EFH for various federally managed fish species within the Pacific Coast Groundfish, Coastal Pelagic Species, and Highly Migratory Species FMPs. Therefore, pursuant to section 305(b)(4)(A) of the MSA, NMFS offers the following EFH Conservation Recommendation to avoid, minimize, mitigate, or otherwise offset the adverse effects to EFH.

1. Although the majority of Falcon 9 First Stage landings are expected to occur on land, an unsuccessful barge landing attempt at sea would result in the discharge of unrecoverable marine debris. Given that up to 6 launches would occur annually, the potential for multiple discharges of marine debris could result in cumulative impacts to ocean floor habitats. Therefore, Vandenberg AFB should coordinate with NMFS to develop an appropriate compensatory mitigation plan to offset these impacts. One option to consider is contributing to an existing marine debris removal program (e.g., derelict fishing gear).

Statutory Response Requirement

Please be advised that regulations at section 305(b)(4)(B) of the MSA and 50 CFR 600.920(k) of the MSA require your office to provide a written response to this letter within 30 days of its receipt and at least 10 days prior to final approval of the action. A preliminary response is acceptable if final action cannot be completed within 30 days. Your final response must include a description of measures to be required to avoid, mitigate, or offset the adverse impacts of the activity. If your response is inconsistent with our EFH Conservation Recommendations, you must provide an explanation of the reasons for not implementing those recommendations. The reasons must include the scientific justification for any disagreements over the anticipated effects of the proposed action and the measures needed to avoid, minimize, mitigate, or offset such effects.

Supplemental Consultation

Pursuant to 50 CFR 600.920(l), the Corps must reinitiate EFH consultation with NMFS if the proposed action is substantially revised in a way that may adversely affect EFH, or if new information becomes available that affects the basis for NMFS' EFH Conservation Recommendations.

FISH AND WILDLIFE COORDINATION ACT

The purpose of the Fish and Wildlife Coordination Act (FWCA) is to ensure that wildlife conservation receives equal consideration, and is coordinated with other aspects of water resources development [16 U.S.C. 661]. The FWCA establishes a consultation requirement for Federal departments and agencies that undertake any action that proposes to modify any stream or other body of water for any purpose, including navigation and drainage [16 U.S.C 662(a)]. Consistent with this consultation requirement, NMFS provides recommendations and comments to Federal action agencies for the purpose of conserving fish and wildlife resources. The FWCA allows the opportunity to offer recommendations for the conservation of species and habitats beyond those currently managed under the MSA. NMFS has determined that ocean floor habitat may be negatively impacted by proposed project activities. As such, an EFH Conservation Recommendation provided above also serves as a FWCA recommendation to compensate for these negative impacts.

MARINE MAMMAL PROTECTION ACT

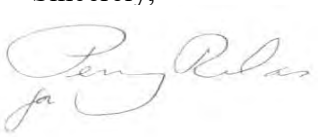
Although several marine mammal species are listed as federally endangered or threatened under the ESA, the Marine Mammal Protection Act of 1972 (MMPA) is the principal Federal legislation that guides marine mammal species protection and conservation. Under the MMPA, "take" of a marine mammal is permitted by NMFS under an Incidental Harassment Authorization (IHA) when the specified activity is incidental, but not intentional, of a small number of marine mammals.

As discussed in detail under the ESA section of this letter, sounds introduced into the sea by man-made devices could have a deleterious effect on marine mammals by causing stress or injury, interfering with communication and predator/prey detection, and changing behavior. Acoustic exposure to loud sounds may result in a temporary or permanent loss of hearing (termed a temporary (TTS) or permanent (PTS) threshold shift) depending upon the location of the marine mammal in relation to the source of the sound. NMFS is currently in the process of determining safety criteria (*i.e.,* guidelines) for marine species exposed to underwater sound. However, pending adoption of these guidelines we have preliminarily determined, based on past projects, consultations with experts, and published studies, that 180 dB_{rms} re 1 μPa (190 dB_{rms} re 1 μPa for pinnipeds) is the impulse

sound pressure level that can be received by marine mammals without injury. Marine mammals have shown behavioral changes when exposed to impulse sound pressure levels of 160 dB_{rms} re 1 µPa and when exposed to non-impulse sound pressure levels of 120 dB_{rms} re 1 µPa. Based on the estimated noise levels expected to be produced by the proposed project, it may be necessary to receive authorization from NMFS under the MMPA for Level B harassment, specifically for the potential for behavioral harassment as a result of the proposed project activities. Most incidental take authorizations to date have involved the incidental harassment of marine mammals by noise. SpaceX has submitted an application to NMFS requesting an IHA for this action, which is currently under review by NMFS' Office of Protected Resources.

Thank you for coordinating with NMFS regarding this project. We appreciate your efforts to comply with Federal regulations and to conserve and protect marine mammals, sea turtles, fish, and essential fish habitat. Please direct questions regarding this letter to Monica.DeAngelis, 562-980-3232, Monica.DeAngelis@noaa.gov for ESA and MMPA, and Eric Chavez 562-980-4064, Eric.Chavez@noaa.gov for EFH.

Sincerely,



William W. Stelle, Jr.
Regional Administrator

cc: Darryl York, Chief, Conservation 30 CES/CEIE Vandenberg AFB
Administrative File: 151422WCR2015PR00190

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APPENDIX F: Native American Tribal Consultation

KAISERSATT, SAMANTHA O CIV USAF AFSPC 30 CES/CEIEA

From: RYAN, CHRISTOPHER D GS-12 USAF AFSPC 30 CES/CEANC
Sent: Tuesday, October 14, 2014 1:14 PM
To: Sam Cohen; Freddie Romero
Subject: Section 106 for the Re-Use of Space Launch Complex 4 West, Part 1
Attachments: Archaeo Survey of SLC-4W--SpaceX Falcon Landing (final 6-9-14).pdf; Scaffolding footings.docx
Signed By: christopher.ryan.7@us.af.mil

Hello Sam, Hello Freddie:

I hope you are well. VAFB proposes to permit the Space Exploration Technologies Corporation (SpaceX) to lease and renovate Space Launch Complex 4 West (SLC-4W) for the purposes of testing and operating its Falcon Launch Vehicle Program. Currently, SpaceX leases and operates the eastern part of the SLC-4 complex, SLC-4E, to assemble and launch the Falcon 9. SpaceX would use SLC-4W as the 'boost-back' site, meaning the Falcon 9 that launches from SLC-4E would, once the second stage separates and fires, have the first stage turn around, reverse course, and execute a controlled landing at SLC-4W. With this e-mail and attachments, VAFB is initiating consultation with the Tribe pursuant to Section 106 of the NHPA.

Within the APE there are three cultural resources: one isolated prehistoric artifact, prehistoric site complex CA-SBA-0537/1816, and the SLC-4W launch facility. CA-SBA-537 and CA-SBA-1816 were determined eligible for the National Register. SLC-4 is not eligible for the NRHP is because it was constructed in 1961 and does not possess exceptional significance, and also because it lacks integrity. Originally constructed as an Atlas Agena launch complex, it was modified to launch Titan rockets, and then suffered extensive damage during a failed Titan launch in April 1986.

20 shovel test pits (STPs) excavated in 2005 by Applied EarthWorks within the SLC-4W fence line encountered mixed soils containing modern material; 10 of the STPs recovered only 29 pieces of flaked-stone debitage from undisturbed sediments. One test excavation unit recovered only 43 flakes. The investigation resulted in a finding that project activities would not adversely affect the site complex. The SHPO concurred. Additional detail regarding the archaeological deposits within the fence line and the assessment of no adverse effect is provided in Chapter 5 of the attached report by Applied EarthWorks. Also in that report, Figure 4-1 and Figure 4-2 illustrate how heavily the natural landscape was modified to create SLC-4W. In Figure 1-4, the area depicting the footprint of the temporary scaffolding will have footings placed on the ground surface as shown in the attached Word document. VAFB determined the proposed undertaking would not adversely affect historic properties. I will send the Area of Direct Impacts map and the Area of Potential Effects map in a separate e-mail immediately following this one, as I don't want the e-mail size to get too big.

VAFB requests Tribal comments on the proposed undertaking. If you have any questions or require additional information, please contact me at (805) 605-0748 or via e-mail at christopher.ryan.7@us.af.mil. Thank you for your assistance with this undertaking. I will be out of the office on Thursday and Friday of this week, and on Monday of next week.

Respectfully,
Christopher Ryan

Cultural Resources Mgmt
1028 Iceland Ave, Bldg 11146
VAFB, CA 93437-6010
805.605.0748

SANTA YNEZ BAND OF MISSION INDIANS
Tribal Elders Council

July 28, 2015

Chris Ryan
VAFB Cultural Resource Mgmt.
1028 Iceland Avenue
Vandenberg, Calif. 93437-6010

Re: SLC4 reuse/Space-X

Chris,

The SYBCI Elders have had a chance to review the documents for this project, as well as a site visit by our representative and at this time have no concerns with this project moving forward.

However, if Space-X decides to do any work other than specified in their documents and relayed to our representative, i.e. removal of building located in southwest corner of complex, the Elders Council would ask that our office be contacted prior to any work being completed for further discussion and expression of any concerns that the council may have.

As always, we thank you for the continued support for the protection and preservation of our cultural heritage located on these ancestral lands.

Should you have any further questions, please call Freddie Romero @ 805-688-7997 or email him at freddyromero1959@yahoo.com.

Sincerely,

Freddie R. Romero Signed on behalf of Tonie Flores

Tonie Flores, Chairperson
SYBCI Elders Council

APPENDIX G: Species Observed During Field Surveys

Table G-1. Plant species observed during field surveys at the SLC-4 complex.

Species	Common Name	Status	Source
Acaena pinnatifida var. californica	Acaena	Native	MSRS 2010
Achillea millefolium	Common yarrow	Native	MSRS 2010
Acmispon glaber	Deer weed	Native	MSRS 2010
Acmispon junceus var. junceus	Rush deerweed	Native	MSRS 2010
Acmispon strigosus	Annual deervetch	Native	MSRS 2010
Aira caryophyllea	European hairgrass	Non-native	MSRS 2010
Amsinkia menziesii var. intermedia	Fiddleneck	Native	MSRS 2010
Anagalis arvensis	Scarlet pimpernel	Non-native	MSRS 2010
Antirrhinum kelloggii	Twining snapdragon	Native	MSRS 2010
Artemisia californica	California sagebrush	Native	MSRS 2010
Asphodelus fistulosus	Onion weed	Non-native	MSRS 2010
Astragalus nuttallii var. nuttallii	Locoweed	Native	MSRS 2010
Avena barbata	Slender wild oat	Non-native	MSRS 2010
Baccharis pilularis	Coyote brush	Native	MSRS 2010
Brassica nigra	Black mustard	Non-native	MSRS 2010
Brassica tournefortii	Saharan mustard	Non-native	MSRS 2010
Bromus diandrus	Rip-gut brome	Non-native	MSRS 2010
Bromus hordeaceus	Soft brome	Non-native	MSRS 2010
Bromus madritensis	Red brome	Non-native	MSRS 2010
Calandrinia ciliata	Red maids	Native	MSRS 2010
Calystegia macrostegia	Morning glory	Native	MSRS 2010
Camissonia strigulosa	Sandysoil suncup	Native	MSRS 2010
Camissoniopsis cheiranthifolia	Beach evening primrose	Native	MSRS 2010
Camissoniopsis intermedia	Intermediate suncup	Native	MSRS 2010
Camissoniopsis micrantha	Miniature suncup	Native	MSRS 2010
Cardionema ramosissima	Tread lightly	Native	MSRS 2010
Carduus pycnocephalus	Italian thistle	Non-native	MSRS 2010
Carpobrotus chilensis	Iceplant	Non-native	MSRS 2010
Carpobrotus edulis	Iceplant	Non-native	MSRS 2010
Castilleja exserta	Purple owl's clover	Native	MSRS 2010
Centaurea melitensis	Tacolote	Non-native	MSRS 2010
Chenopodium californicum	California goosefoot	Native	MSRS 2010
Conicosia pugioniformis	Narrow-leafed iceplant	Non-native	MSRS 2010
Corethrogyne filaginifolia	Common sand aster	Native	MSRS 2010
Cortaderia jubata	Jubata grass	Non-native	MSRS 2010
Cotula australis	Australian brass button	Non-native	MSRS 2010
Crassula connata	Pygmyweed	Native	MSRS 2010
Croton californica	Croton	Native	MSRS 2010
Cryptantha intermedia	Common cryptantha	Native	MSRS 2010
Cryptantha leiocarpa	Coastal cryptantha	Native	MSRS 2010

Species	Common Name	Status	Source
Cynodon dactylon	Bermuda grass	Non-native	MSRS 2010
Daucus pusillus	Wild carrot	Native	MSRS 2010
Dichelostemma capitatum	Bluedicks	Native	MSRS 2010
Dienandra increscens increscens	Tarplant	Native	MSRS 2010
Dudleya sp.	Liveforever	Native	MSRS 2010
Ehrharta calycina	Veldt grass	Non-native	MSRS 2010
Ericameria ericoides	Mock heather	Native	MSRS 2010
Erigeron bonariensis	South American horseweed	Non-native	MSRS 2010
Eriogonum parvifolium	Seacliff buckwheat	Native	MSRS 2010
Eriophyllum staechadifolium	Coastal woolly sunflower	Native	MSRS 2010
Erodium botrys	Stork-bill filaree	Non-native	MSRS 2010
Erodium cicutarium	Red-stem filaree	Non-native	MSRS 2010
Erysimum capitatum	Western wallflower	Native	MSRS 2010
Eschscholzia californica	California poppy	Native	MSRS 2010
Festuca myuros	Rattail fescue	Non-native	MSRS 2010
Filago californica	Herba impa	Native	MSRS 2010
Frageria vesca	Wild strawberry	Native	MSRS 2010
Galium porrigens	Climbing bedstraw	Native	MSRS 2010
Hedypnois cretica	Crete weed	Non-native	MSRS 2010
Heteromeles arbutifolia	Toyon	Native	MSRS 2010
Heterotheca grandiflora	Telegraph weed	Native	MSRS 2010
Hirschfeldia incana	Perenial mustard	Non-native	MSRS 2010
Hordeum marinum	Mediterranean barley	Non-native	MSRS 2010
Horkelia cuneata	Kellogg's horkelia	Native	MSRS 2010
Hosackia oblongifolia var. oblongifolia	Deervetch	Native	MSRS 2010
Hypochaeris glabra	Smoothe cat's ear	Non-native	MSRS 2010
Isocoma menziesii	Coastal goldenbush	Native	MSRS 2010
Juncus patens	Spreading rush	Native	MSRS 2010
Lepidium nitidum	Peppercress	Native	MSRS 2010
Lobularia maritima	Sweet alyssum	Non-native	MSRS 2010
Lupinus arboreus	Bush lupine	Native	MSRS 2010
Lupinus bicolor	Miniature lupine	Native	MSRS 2010
Lupinus nanus	Sky lupine	Native	MSRS 2010
Lupinus succulentus	Arroyo lupine	Native	MSRS 2010
Lupinus truncatus	Truncate lupine	Native	MSRS 2010
Marah fabaceus	California manroot	Native	MSRS 2010
Marubium vulgare	Bur clover	Non-native	MSRS 2010
Melilotus indicus	Yellow sweet clover	Non-native	MSRS 2010
Mimulus aurantiacus	Sticky monkeyflower	Native	MSRS 2010
Oxalis pes-caprae	Bermuda buttercup	Non-native	MSRS 2010
Phacelia distans	Common phacelia	Native	MSRS 2010

Species	Common Name	Status	Source
Plantago coronopus	Cut-leaf plantain	Non-native	MSRS 2010
Plantago errecta	Annual plantain	Native	MSRS 2010
Polycarpon tetraphyllum	four leafed allseed	Non-native	MSRS 2010
Polygonum arenastrum	Common knotweed	Non-native	MSRS 2010
Polystichum munitum	Western sword fern	Native	MSRS 2010
Potentilla glandulosa	Sticky cinquefoil	Native	MSRS 2010
Pseudognaphalium californicum	California everlasting	Native	MSRS 2010
Pseudognaphalium luteoalbum	Weedy cudweed	Non-native	MSRS 2010
Pseudognaphalium ramosissimum	Pink cudweed	Native	MSRS 2010
Pteridium aquilinum	Western brackenfern	Native	MSRS 2010
Pterostegia drymarioides	Notchleaf	Native	MSRS 2010
Quercus agrifolia	Coast live oak	Native	MSRS 2010
Rhamnus californica	California coffee berry	Native	MSRS 2010
Rhus integrifolia	Lemonade berry	Native	MSRS 2010
Rubus ursinus	Blackberry	Native	MSRS 2010
Rumex acetosella	Sheep sorrel	Non-native	MSRS 2010
Rumex crispus	Curley dock	Non-native	MSRS 2010
Salvia mellifera	Black sage	Native	MSRS 2010
Sambucus mexicana	Mexican elderberry	Native	MSRS 2010
Senecio glomeratus	Australian fireweed	Non-native	MSRS 2010
Silene gallica	Windmill pink	Non-native	MSRS 2010
Solanum douglasii	Douglas' nightshade	Native	MSRS 2010
Solanum xanti	Purple nightshade	Native	MSRS 2010
Sonchus asper	Prickly sow thistle	Non-native	MSRS 2010
Sonchus oleraceus	Common sow thistle	Non-native	MSRS 2010
Spergula arvensis ssp. arvensis	Corn spurry	Non-native	MSRS 2010
Stachys bullata	Hedge nettle	Native	MSRS 2010
Stellaria media	Common chickweed	Non-native	MSRS 2010
Stipa lepida	Foothill needlegrass	Native	MSRS 2010
Toxicodendron diversilobum	Poison oak	Native	MSRS 2010

Source: ManTech SRS Technologies, Inc. 2010. Biological Assessment Falcon 9 and Falcon 9 Heavy Space Vehicle Program from Space Launch Complex 4 East Vandenberg Air Force Base, California. Prepared for Space Exploration Technologies and 30th Civil Engineer Squadron, Asset Management Flight. 26 pp.

Table G-2. Animal species observed during field surveys within the SLC-4 complex. Special status species are shown in red.

Species name	Common name	Status	Occurrence	Source
Butterflies				
Callophrys perplexa	Perplexing hairstreak	Native	Observed	MSRS 2010
Everes amyntula	Western tailed blue	Native	Observed	MSRS 2010
Glaucopsyche lygdamus	Silvery blue	Native	Observed	MSRS 2010
Coenonympha californica	Common Ringlet	Native	Observed	MSRS 2010
Danaus plexippus	Monarch Butterfly	Native	Observed	MSRS 2015 field surveys
Reptiles and Amphibians				
Sceloporus occidentalis	Western fence lizard	Native	Observed	MSRS 2010
Elgaria multicarinata	Southern alligator lizard	Native	Observed	MSRS 2010
Thamnophis elegans	Western terrestrial gartersnake	Native	Observed	MSRS 2010
Birds				
Cathartes aura	Turkey Vulture	Native	Observed	MSRS 2010
Buteo jamaicensis	Red-tailed Hawk	Native, likely to nest on site	Observed	MSRS 2010
Callipepla californica	California Quail	Native, likely to nest on site	Observed	MSRS 2010
Charadrius vociferus	Killdeer	Native, likely to nest on site	Observed	MSRS 2010
Zenaida macroura	Mourning Dove	Native, likely to nest on site	Observed	MSRS 2010
Bubo virginianus	Great Horned Owl	Native, likely to nest on site	Observed	MSRS 2010
Calypte anna	Anna's Hummingbird	Native, likely to nest on site	Observed	MSRS 2010
Colaptes auratus	Northern Flicker	Native, likely to nest on site	Observed	MSRS 2010
Empidonax difficilis	Pacific-slope Flycatcher	Native, likely to nest on site	Observed	MSRS 2010
Sayornis nigricans	Black Phoebe	Native, likely to nest on site	Observed	MSRS 2010
Eremophila alpestris	Horned Lark	Native	Observed	MSRS 2010
Petrochelidon pyrrhonota	Cliff Swallow	Native, likely to nest on site	Observed	MSRS 2010
Hirundo rustica	Barn Swallow	Native, likely to nest on site	Observed	MSRS 2010
Psaltriparus minimus	Bushtit	Native, likely to nest on site	Observed	MSRS 2010
Thryomanes bewickii	Bewick's Wren	Native, likely to nest on site	Observed	MSRS 2010
Sialia mexicana	Western Bluebird	Native, likely to nest on site	Observed	MSRS 2010
Chamaea fasciata	Wrentit	Native, likely to nest on site	Observed	MSRS 2010
Toxostoma redivivum	California Thrasher	Native, likely to nest on site	Observed	MSRS 2010
Wilsonia pusilla	Wilson's Warbler	Native, likely to nest on site	Observed	MSRS 2010
Dendroica coronata	Yellow-rumped Warbler	Native	Observed	MSRS 2010

Species name	Common name	Status	Occurrence	Source
Melospiza melodia	Song Sparrow	Native, likely to nest on site	Observed	MSRS 2010
Zonotrichia leucophrys	White-crowned Sparrow	Native, likely to nest on site	Observed	MSRS 2010
Pipilo maculatus	Spotted Towhee	Native, likely to nest on site	Observed	MSRS 2010
Pipilo crissalis	California Towhee	Native, likely to nest on site	Observed	MSRS 2010
Carduelis psaltria	Lesser Goldfinch	Native, likely to nest on site	Observed	MSRS 2010
Carpodacus mexicanus	House Finch	Native, likely to nest on site	Observed	MSRS 2010
Carpodacus purpureus	Purple Finch	Native, likely to nest on site	Observed	MSRS 2010
Mammals				
Spermophilus beecheyi	California Ground Squirrel	Native	Observed	MSRS 2010
Thomomys bottae	Botta's Pocket Gopher	Native	Observed	MSRS 2010
Microtus californicus	California Vole	Native	Observed	MSRS 2010
Canis latrans	Coyote	Native	Observed	MSRS 2010
Odocoileus hemionus	Mule Deer	Native	Observed	MSRS 2010

Sources:
ManTech SRS Technologies, Inc. 2010. Biological Assessment Falcon 9 and Falcon 9 Heavy Space Vehicle Program from Space Launch Complex 4 East Vandenberg Air Force Base, California. Prepared for Space Exploration Technologies and 30th Civil Engineer Squadron, Asset Management Flight. 26 pp.
ManTech SRS Technologies, Inc. 2015. Pers. obs. By Alice Abela.

APPENDIX H: Notice of Availability for Public Review, Proof of Delivery/Publication, Comments Received on Final Draft, and Responses

DEPARTMENT OF THE AIR FORCE
30TH SPACE WING (AFSPC)

MAR 0 3 2016

MEMORANDUM FOR ALL INTERESTED GOVERNMENT AGENCIES, PUBLIC OFFICIALS, ORGANIZATIONS, AND INDIVIDUAL PARTIES

FROM: 30 CES/CEI
1028 Iceland Avenue
Vandenberg AFB CA 93437-6010

SUBJECT: Final Draft Environmental Assessment (EA) and Finding of No Significant Impact (FONSI) for the Boost-Back and Landing of the Falcon 9 First Stage at SLC-4 West Vandenberg Air Force Base, California and Offshore Landing Contingency Option, Vandenberg Air Force Base (VAFB), California

1. Attached as public and agency notification, to comply with the National Environmental Policy Act of 1969 and the President's Council on Environmental Quality's implementing regulations, is the Final Draft EA and FONSI for the Boost-Back and Landing of the Falcon 9 First Stage at SLC-4 West Vandenberg Air Force Base, California and Offshore Landing Contingency Option, VAFB, California.

2. The Proposed Action is Space Exploration Technologies Corporation's (SpaceX's) project on VAFB (Federal land). SpaceX is now operating the Falcon Launch Vehicle Program at Space Launch Complex 4 East (SLC-4E) on VAFB. SpaceX proposes using first stage recovery (boost-back and landing) by returning the Falcon 9 First Stage to SLC-4W for potential reuse up to six times per year. The Proposed Action includes: (1) constructing a new concrete landing pad at SLC-4W; and (2) the boost-back maneuver (in-air), return flight, and landing of the Falcon 9 First Stage on a new SLC-4W pad. In addition, the Proposed Action includes a contingency landing action if landing on the SLC-4W pad is not feasible. The contingency action is the Falcon 9 First Stage boost-back maneuver and landing on a barge specifically designed for the landing located at least 31 miles (mi.) (50 kilometers [km]) offshore of VAFB. This contingency action would occur if landing the Falcon 9 First Stage on the pad at SLC-4W is not feasible. Resources analyzed in this EA include air quality, sound, biological, water, cultural, geology and earth, human health and safety, hazardous materials and waste management, solid waste management, land use and aesthetics, transportation, Department of Transportation Act Section 4(f) Properties, and utilities, and Coastal Zone management. The EA concludes that there will be no significant environmental impacts resulting from the Proposed Action.

3. The public comment period for this Final Draft EA/FONSI will be from 7 March 2016 through 5 April 2016. Comments may be sent to the above address to the attention of Samantha Kaisersatt, e-mailed to samantha.kaisersatt@us.af.mil, or faxed to (805) 606-6137. If you have any questions, please contact Ms. Samantha Kaisersatt at (805) 605-0392.

BEATRICE L. KEPHART
Chief, Installation Management Flight

Attachment:
Final Draft EA and FONSI for the Boost-Back and Landing of the Falcon 9 First Stage at SLC-4 West Vandenberg Air Force Base, California and Offshore Landing Contingency Option, VAFB, California.

Customer Ad Proof

60010556 ManTech — Order Nbr 77414

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Phone	7032186315	Amount Due	443.90
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SubSection		Insertions	3
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FINAL DRAFT ENVIRONMENTAL ASSESSMENT AND FINDING OF NO SIGNIFICANT IMPACT

BOOST-BACK AND LANDING OF THE FALCON 9 FIRST STAGE AT SLC-4 WEST VANDENBERG AIR FORCE BASE, CALIFORNIA AND OFFSHORE LANDING CONTINGENCY OPTION

VANDENBERG AIR FORCE BASE, CALIFORNIA

The U.S. Air Force and Space Exploration Technologies Corporation (SpaceX) has prepared a Final Draft Environmental Assessment (EA) and Finding of No Significant Impact (FONSI) that evaluates the potential environmental impacts of the boost-back and landing of the Falcon 9 First Stage at Space Launch Complex 4 West (SLC-4W) on Vandenberg Air Force Base (VAFB) and offshore landing contingency option. SpaceX is currently operating the Falcon Launch Vehicle Program at Space Launch Complex 4 East (SLC-4E) on VAFB. SpaceX proposes using first stage recovery (boost-back and landing) by returning the Falcon 9 First Stage to SLC-4W for potential reuse up to six times per year. The Proposed Action includes: (1) constructing a new concrete landing pad at SLC-4W; and (2) the boost-back maneuver (in-air), return flight, and landing of the Falcon 9 First Stage on a new SLC-4W pad. In addition, the Proposed Action includes a contingency landing action if landing on the SLC-4W pad is not feasible. The contingency action is the boost-back and landing of the Falcon 9 First Stage on a barge specifically designed for the landing located at least 31 miles (50 kilometers) offshore of VAFB. This contingency action would occur if landing the Falcon 9 First Stage on the pad at SLC-4W does not occur. Resources analyzed in this EA include air quality, sound, biological resources, water resources, cultural resources, geology and earth resources, human health and safety, hazardous materials and waste management, solid waste management, land use and aesthetics, transportation, Department of Transportation Act Section 4(f) Properties, utilities, and Coastal Zone management. The EA concludes that there will be no significant environmental impacts resulting from the Proposed Action.

The Final Draft EA/FONSI is available for review at the Lompoc, Santa Maria, and Santa Barbara Public Libraries, and the VAFB Library. The public comment period for this Final Draft EA/FONSI is 7 March 2016 through 6 April 2016. Comments may be sent to the 30 CES/CEIEA, 1028 Iceland Avenue, Vandeberg AFB, CA 93437 to the attention of Samantha Kaisersatt, e-mailed to samantha.kaisersatt@us.af.mil, or faxed to (805) 606-6137. If you have any questions, please contact Ms. Samantha Kaisersatt at (805) 605-0392.

Legal #77414
Pub dates: Mar 7, 8, 9, 2016

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60010556 ManTech — Order Nbr 77411

Publication	**Lompoc Record**		
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City St Zip	LOMPOC CA 93436	Amount Paid	0.00
Phone	7032186315	Amount Due	321.35
Fax			
Section	Announcements	Start/End Dates	03/06/2016 - 03/10/2016
SubSection		Insertions	3
Category	986 Legals	Size	95
Ad Key	77411-1	Salesperson(s)	TERESA RAMIREZ
Keywords	FINAL DRAFT ENVIRONMENTAL ASSE	Taken By	TC Ramirez
Notes			

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FINAL DRAFT ENVIRONMENTAL ASSESSMENT AND FINDING OF NO SIGNIFICANT IMPACT

BOOST-BACK AND LANDING OF THE FALCON 9 FIRST STAGE AT SLC-4 WEST VANDENBERG AIR FORCE BASE, CALIFORNIA AND OFFSHORE LANDING CONTINGENCY OPTION

VANDENBERG AIR FORCE BASE, CALIFORNIA

The U.S. Air Force and Space Exploration Technologies Corporation (SpaceX) has prepared a Final Draft Environmental Assessment (EA) and Finding of No Significant Impact (FONSI) that evaluates the potential environmental impacts of the boost-back and landing of the Falcon 9 First Stage at Space Launch Complex 4 West (SLC-4W) on Vandenberg Air Force Base (VAFB) and offshore landing contingency option. SpaceX is currently operating the Falcon Launch Vehicle Program at Space Launch Complex 4 East (SLC-4E) on VAFB. SpaceX proposes using first stage recovery (boost-back and landing) by returning the Falcon 9 First Stage to SLC-4W for potential reuse up to six times per year. The Proposed Action includes: (1) constructing a new concrete landing pad at SLC-4W; and (2) the boost-back maneuver (in-air), return flight, and landing of the Falcon 9 First Stage on a new SLC-4W pad. In addition, the Proposed Action includes a contingency landing action if landing on the SLC-4W pad is not feasible. The contingency action is the boost-back and landing of the Falcon 9 First Stage on a barge specifically designed for the landing located at least 31 miles (50 kilometers) offshore of VAFB. This contingency action would occur if landing the Falcon 9 First Stage on the pad at SLC-4W does not occur. Resources analyzed in this EA include air quality, sound, biological resources, water resources, cultural resources, geology and earth resources, human health and safety, hazardous materials and waste management, solid waste management, land use and aesthetics, transportation, Department of Transportation Act Section 4(f) Properties, utilities, and Coastal Zone management. The EA concludes that there will be no significant environmental impacts resulting from the Proposed Action.

The Final Draft EA/FONSI is available for review at the Lompoc, Santa Maria, and Santa Barbara Public Libraries, and the VAFB Library. The public comment period for this Final Draft EA/FONSI is 7 March 2016 through 6 April 2016. Comments may be sent to the 30 CES/CEIEA, 1028 Iceland Avenue, Vandeberg AFB, CA 93437 to the attention of Samantha Kaisersatt, e-mailed to samantha.kaisersatt@us.af.mil, or faxed to (805) 606-6137. If you have any questions, please contact Ms. Samantha Kaisersatt at (805) 605-0392.

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NOAA – Channel Islands National Marine Sanctuary
Attn: Chris Mobley
113 Harbor Way, Suite 150
Santa Barbara, CA 93l09
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NOAA - National Marine Fisheries Service
Southwest Regional Office
Attn: For Distribution
501 West Ocean Blvd
Long Beach, CA 90802-4213
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Channel Islands National Park
Attn: Superintendent
1901 Spinnaker Drive
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Attn: David A. Jorgenson, P.E.
1318 New Mexico Avenue, Building 9360
Vandenberg AFB, CA 93437
Email: David.A.Jorgenson@usace.army.mil
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Environmental Review Office
Attn: Carol Sachs
Mail Code - ENF-4-2
75 Hawthorne Street
San Francisco, CA 94105
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U.S. Fish and Wildlife Service
Ventura Fish and Wildlife Office
Attn: Jeff Phillips
2493 Portola Road, Suite B
Ventura, CA 93003-7726
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California Coastal Commission - Energy, Ocean Resources and Federal Consistency Division
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Central Coast Regional Water Quality Control Board
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895 Aerovista Place, Suite 101
San Luis Obispo, CA 93401-7906
Email: Sheila.soderberg@waterboards.ca.gov
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Central Coast Regional Water Quality Control Board - Central Coast Ambient Monitoring Program (CCAMP)
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South Coast Region
Attn: Mary Meyer
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Ojai, CA 93024
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California Environmental Protection Agency
Attn: For Distribution
1001 I Street
P.O. Box 2815
Sacramento, CA 95812-2815
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California Office of Historic Preservation
Attn: Carol Roland-Nawi
1725 23rd Street, Suite 100
Sacramento, CA 95816
Email: carol.roland-nawi@parks.ca.gov
Hardcopy

Office of the Governor
Office of Planning and Research
Attn: State Clearinghouse
1400 l0th Street
Sacramento CA 95814
Hardcopy - 15 Copies + NOC (obtain from website)

Santa Barbara County Air Pollution Control District
Attn: Molly Pearson
260 N. San Antonio Road, Suite A
Santa Barbara, CA 93110-1315
Email: pearsonm@sbcapcd.org
Electronic Copy

Tribes

Santa Ynez Band of Chumash Indians
Elders Council
Attn: Sam Cohen & Freddie Romero
P.O. Box 517
Santa Ynez, CA 93460
Emails: FRomero@santaynezchumash.org
SCohen@santaynezchumash.org
Electronic Copy

Local

Santa Barbara County Board of Supervisors
C/O: Santa Barbara County Planning & Development
Attn: David Villalobos
123 E. Anapamu Street
Santa Barbara, CA 93101
Email: dvillalo@co.santa-barbara.ca.us
Electronic Copy

Santa Barbara County Planning & Development
Attn: Heather Allen
123 East Anapamu Street
Santa Barbara CA 93101-2058
Email: hallen@co.santa-barbara.ca.us
Electronic Copy

City of Lompoc
Economic & Community Development
Attn: Lucille Breese
100 Civic Center Plaza
Lompoc CA 93436
Email: l_breese@ci.lompoc.ca.us
Hardcopy

Libraries

Santa Barbara Public Library
40 East Anapamu Street
Santa Barbara, CA 93101-2000
Hardcopy

Lompoc Public Library
501 East North Avenue
Lompoc, CA 93436
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Santa Maria Public Library
421 S. McClelland Street
Santa Maria, CA 93454
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Requesting Entities

California Native Plant Society
Channel Islands Chapter
Attn: David Magney
P.O. Box 6
Ojai, CA 93024-006
Email: president@cnpsci.org
Electronic Copy

California Trout
Attn: Kurt Zimmerman
701 E. Santa Clara St.
Ventura, CA 93001
Email: kurtfz63@yahoo.com
NOA Only

Environmental Defense Center
Attn: Brian Trautwein
906 Garden Street
Santa Barbara, CA 93101
Email:
BTrautwein@EnvironmentalDefenseCenter.org
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La Purisima Audubon Society
Attn: Tamarah Taaffe
4036 Muirfield Place
Vandenberg Village, CA
93436-1307
Email: bima55@msn.com
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Santa Barbara Museum of Natural History
Attn: Luke J. Swetland
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Santa Barbara, CA 93105
Email: lswetland@sbnature2.org
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Sierra Club
Los Padres Chapter
Attn: Gerry Ching
P O Box 31241
Santa Barbara, CA 93130-1241
Email: gching@cox.net
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Jordan Carduner
NOAA Fisheries

Electronic Copy

Xochitl Rocha
3/5/16

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Lompoc, CA 93436-3404

NOTES

Draft Final Environmental Assessment

RECEIPT

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Santa Barbara County
Air Pollution Control District

April 5, 2015

Samantha Kaisersatt
30 CES/CEI
1028 Iceland Avenue
Vandenberg AFB CA 93437-6010

Re: APCD Comments on Final Draft Environmental Assessment and Finding of No Significant Impact (FONSI) for the Boost-Back and Landing of the Falcon 9 First Stage at SLC-4 West Vandenberg Air Force Base, California and Offshore Landing Contingency Option, Vandenberg air Force Base (VAFB)

Dear Ms. Kaisersatt:

The Air Pollution Control District (APCD) has reviewed the Draft Environmental Assessment (EA) for the referenced project. Space Exploration Technologies Corporation (SpaceX) currently operates the Falcon Launch Vehicle Program at Space Launch Complex 4 East (SLC-4E) on VAFFB. SpaceX proposes to use first stage recovery (boost-back and landing) by returning the Falcon 9 First Stage to SLC-4W for potential reuse up to six times per year. The proposed action includes:

1. constructing a new concrete landing pad at SLC-4W; and
2. the boost-back maneuver (in-air), return flight, and landing of the Falcon 9 First Stage on a new SLC-4W pad.

In addition the proposed action includes a contingency landing action if landing on the SLC-4W pad is not feasible. The contingency action is the Falcon 9 First Stage boost-back maneuver and landing on a barge specifically designed for the landing located at least 31 miles offshore of VAFB. This contingency action would occur if landing the Falcon 9 First Stage on the pad at SLC-4W is not feasible.

The APCD acknowledges that, as stated in the Draft EA on Page 48, SpaceX anticipates that the proposed action would not require any stationary sources. However, the proposed project may include equipment that is subject to APCD permit requirements and prohibitory rules. If the project does require an APCD permit or modifications to the existing SpaceX permit at VAFB, APCD may be a lead agency under the California Environmental Quality Act (CEQA).

Air Pollution Control District staff offers the following comments on the Draft EA:

1. **Section 2.3.4.2, Air Quality – 2 (Air-2), page 31**: The last bullet item for this Environmental Protection Measure states, *"If the project construction extends into 2016..."* The language in this measure should be revised to reflect the fact that project construction will not begin until 2016 or later. The text in the second-to-last paragraph on Page 127 should also be revised accordingly.

2. **Section 3.1, Air Quality, Table 3-1, Ambient Air Quality Standards, page 45:** Please revise Table 3-1, and the discussion in Section 3.1, to reflect the federal 8-hour ozone standard of 0.075 ppm that was adopted in 2008, and the recently revised 8-hour federal standard of 0.70 that was adopted in October, 2015. Final attainment/nonattainment designations for the revised standard will be made in October, 2017.

3. **Section 3.1.5, Local Requirements, Page 49:** This section includes a statement that, *"The District has adopted a screening threshold of 10,000 metric tons of carbon dioxide equivalents (CO2e) per year consistent with Assembly Bill (AB) 32."* For clarification, the basis for the District's 10,000 metric ton/year screening threshold was not AB 32. The basis for the 10,000 metric ton/year screening threshold is provided in the staff report available for review on the District's website at www.ourair.org/greenhouse-gases-and-ceqa/. Please correct the text in this section and in the second-to-last paragraph on Page 133.

4. **Section 4.1.1.2, Boost-Back and Landing at SLC-4W, Pages 128-130:** *The last paragraph of this section, at the top of Page 130, states that "Operational emissions for all pollutants are below the major source threshold of 100 tons per year for all criteria pollutants; therefore, the Proposed Action would result in less than significant impacts to air quality."* It should be noted that the APCD has adopted air quality significance thresholds, for projects subject to review under the California Environmental Quality Act (CEQA), that are much lower than the federal major source threshold of 100 tons per year. The APCD's thresholds are contained in the *APCD Environmental Review Guidelines* and are available for review on the District's website at www.ourair.org/land-use/

5. **Section 4.1.1.3, Contingency Barge Landing, Page 130:** This section includes a discussion, in the third paragraph, of a 3 nautical mile limit being the boundary for the local air district. Please refer to SCBAPCD Rule 102 that defines California Coastal Waters adjacent to the SBCAPCD as being within the boundaries of the air district. Please correct this statement. Also, please correct the similar statement in the last paragraph of Section 4.1.4.1, on Page 134.

Air Pollution Control District staff recommends that the following measures be applied to the project:

6. Standard dust mitigations (**Attachment A**) are recommended for all construction and/or grading activities. The name and telephone number of an on-site contact person must be provided to the APCD prior to issuance of grading/building permit issuance.

7. APCD Rule 345, *Control of Fugitive Dust from Construction and Demolition Activities* establishes limits on the generation of visible fugitive dust emissions at demolition and construction sites. The rule includes measures for minimizing fugitive dust from on-site activities and from trucks moving on- and off-site. The text of the rule can be viewed on the APCD website at www.ourair.org/wp-content/uploads/rule345.pdf

8. The State of California considers particulate matter emitted by diesel engines carcinogenic. Therefore, during project grading, construction, and hauling, construction contracts must specify that contractors shall adhere to the requirements listed in **Attachment B** to reduce emissions of particulate matter from diesel equipment as well as of ozone precursors.

9. The proposed project involves operations that are currently subject to APCD permitting requirements, rules, and regulations. Should the project implementation necessitate modifications to the current APCD Permit to Operate, those modifications must be addressed through the APCD's permitting process ***prior to construction of the project***. *The APCD permit process can take several months. To avoid delay, the applicant is encouraged to submit their Authority to Construct permit application to the APCD as soon as possible, see www.ourair.org/permit-applications/ to download the necessary permit application(s).*

If have any questions regarding these comments, please feel free to contact me at (805) 961-8838 or via email at mmp@sbcapcd.org.

Sincerely,

Molly Pearson
Planning & Grants Supervisor
Technology and Environmental Assessment Division

Attachments: Fugitive Dust Control Measures
Diesel Particulate and NO_x Emission Measures

cc: TEA Chron File

Santa Barbara County
Air Pollution Control District

ATTACHMENT A
FUGITIVE DUST CONTROL MEASURES

These measures are required for all projects involving earthmoving activities regardless of the project size or duration. Proper implementation of these measures is assumed to fully mitigate fugitive dust emissions.

- During construction, use water trucks or sprinkler systems to keep all areas of vehicle movement damp enough to prevent dust from leaving the site. At a minimum, this should include wetting down such areas in the late morning and after work is completed for the day. Increased watering frequency should be required whenever the wind speed exceeds 15 mph. Reclaimed water should be used whenever possible. However, reclaimed water should not be used in or around crops for human consumption.

- Minimize amount of disturbed area and reduce on site vehicle speeds to 15 miles per hour or less.

- If importation, exportation and stockpiling of fill material is involved, soil stockpiled for more than two days shall be covered, kept moist, or treated with soil binders to prevent dust generation. Trucks transporting fill material to and from the site shall be tarped from the point of origin.

- Gravel pads shall be installed at all access points to prevent tracking of mud onto public roads.

- After clearing, grading, earth moving or excavation is completed, treat the disturbed area by watering, or revegetating, or by spreading soil binders until the area is paved or otherwise developed so that dust generation will not occur.

- The contractor or builder shall designate a person or persons to monitor the dust control program and to order increased watering, as necessary, to prevent transport of dust offsite. Their duties shall include holiday and weekend periods when work may not be in progress. The name and telephone number of such persons shall be provided to the Air Pollution Control District prior to land use clearance for map recordation and land use clearance for finish grading of the structure.

  Plan Requirements: All requirements shall be shown on grading and building plans and as a note on a separate information sheet to be recorded with map. **Timing**: Requirements shall be shown on plans or maps prior to land use clearance or map recordation. Condition shall be adhered to throughout all grading and construction periods.

  MONITORING: Lead Agency shall ensure measures are on project plans and maps to be recorded. Lead Agency staff shall ensure compliance onsite. APCD inspectors will respond to nuisance complaints.

Santa Barbara County
Air Pollution Control District

ATTACHMENT B
DIESEL PARTICULATE AND NO_x EMISSION MEASURES

Particulate emissions from diesel exhaust are classified as carcinogenic by the state of California. The following is an updated list of regulatory requirements and control strategies that should be implemented to the maximum extent feasible.

The following measures are required by state law:

- All portable diesel-powered construction equipment shall be registered with the state's portable equipment registration program OR shall obtain an APCD permit.
- Fleet owners of mobile construction equipment are subject to the California Air Resource Board (CARB) Regulation for In-use Off-road Diesel Vehicles (Title 13 California Code of Regulations, Chapter 9, § 2449), the purpose of which is to reduce diesel particulate matter (PM) and criteria pollutant emissions from in-use (existing) off-road diesel-fueled vehicles. For more information, please refer to the CARB website at www.arb.ca.gov/msprog/ordiesel/ordiesel.htm.
- All commercial diesel vehicles are subject to Title 13, § 2485 of the California Code of Regulations, limiting engine idling time. Idling of heavy-duty diesel construction equipment and trucks during loading and unloading shall be limited to five minutes; electric auxiliary power units should be used whenever possible.

The following measures are recommended:

- Diesel construction equipment meeting the California Air Resources Board (CARB) Tier 1 emission standards for off-road heavy-duty diesel engines shall be used. Equipment meeting CARB Tier 2 or higher emission standards should be used to the maximum extent feasible.
- Diesel powered equipment should be replaced by electric equipment whenever feasible.
- If feasible, diesel construction equipment shall be equipped with selective catalytic reduction systems, diesel oxidation catalysts and diesel particulate filters as certified and/or verified by EPA or California.
- Catalytic converters shall be installed on gasoline-powered equipment, if feasible.
- All construction equipment shall be maintained in tune per the manufacturer's specifications.
- The engine size of construction equipment shall be the minimum practical size.
- The number of construction equipment operating simultaneously shall be minimized through efficient management practices to ensure that the smallest practical number is operating at any one time.
- Construction worker trips should be minimized by requiring carpooling and by providing for lunch onsite.

Plan Requirements: Measures shall be shown on grading and building plans. **Timing:** Measures shall be adhered to throughout grading, hauling and construction activities.

MONITORING: Lead Agency staff shall perform periodic site inspections to ensure compliance with approved plans. APCD inspectors shall respond to nuisance complaints.

Draft Final Environmental Assessment
Boost-Back and Landing of the Falcon 9 Full Thrust First Stage at SLC-4 West
Vandenberg Air Force Base, California and Offshore Landing Contingency Option
Public Comment U.S. Air Force Response Matrix

Affiliation	Contact	Comment #	Scope/Section	Comment	Response
SB County APCD	Molly Pearson	1	Air Quality Section 2.3.4.2 Pg. 31, 127	The last bullet item for this Environmental Protection Measure states "If the project construction extends into 2016..." The language in this measure should be revised to reflect the fact that the project construction will not begin until 2016 or later. The text in the second to last paragraph on pg. 127 should also be revised accordingly.	Changed to: "All in-use heavy-duty diesel-fueled vehicles with a GVWR greater than 26,000 lb. (e.g., trucks and buses) must meet particulate matter best available control technology and engine model year emission requirements as specified in the CARB Regulation to Reduce Emissions of Diesel Particulate Matter, Oxides of Nitrogen and Other Criteria Pollutants from In-Use Heavy-Duty Diesel-Fueled Vehicles."
SB County APCD	Molly Pearson	2	Section 3.1 Table 3-1 pg. 45	Please revise table 3-1, and the discussion in Section 3.1, to reflect the federal 8-hour ozone standard of 0.075 ppm that was adopted in 2008, and the recently revised 8-hour federal standard of 0.070 that was adopted in October, 2015. Final attainment/nonattainment designations for the revised standards will be made in October, 2017.	Corrected in accordance with the comment.
SB County APCD	Molly Pearson	3	Section 3.1.5 Pg. 49	This section includes a statement that, "The district has adopted a screening threshold of 10,000 metric tons of carbon dioxide equivalents (CO2e) per year consistent with Assembly Bill (AB) 32." For clarification, the basis for the district's 10,000 metric ton/year screening threshold was not AB 32. The basis for the 10,000 metric ton/year screening threshold is provided in the staff report available for review on the Districts website at www.ourair.org/greenhouse-gases-and-ceqa/. Please correct the text in this section and in the second to last paragraph on page 133.	"consistent with AB 32" was removed from text at both locations.
SB County APCD	Molly Pearson	4	Section 4.1.1.2 Pg. 128-130	The last paragraph of this section, at the top of page 130, states that "Operational emissions for all pollutants are below the major source threshold of 100 tons per year for all criteria pollutants; therefore, the Proposed Action would result in less than significant impacts to air quality." It should be noted that the APCD has adopted air quality significance thresholds, for projects subject to review under the California Environmental Quality Act (CEQA), that are much lower than the federal major source threshold of 100 tons per year. The APCD's thresholds are contained in the APCD Environmental Review Guidelines and are available for review on the District's website at www.ourair.org/land-use/	Changed to: "Operational emissions for all pollutants are below the federal major source threshold of 100 tons per year for all criteria pollutants; therefore, the Proposed Action would result in less than significant impacts to air quality. The SBCAPCD has adopted air quality significance thresholds, for projects subject to review under CEQA, that are much lower than the federal major source threshold. Any air quality permits required for the Proposed Action are subject to CEQA review by the SBCAPCD. The SBCAPCD's thresholds are contained in the SBCAPCD Environmental Review Guidelines and are available for review on the District's website at www.ourair.org/land-use/."
SB County APCD	Molly Pearson	5	Section 4.1.1.3 Pg. 130	This section includes a discussion, in the third paragraph, of a 3 nautical mile limit being the boundary for the local air district. Please refer to SBCAPCD Rule 102 that defines California Coastal Waters adjacent to the SBCAPCD as being within the boundaries of the air district. Please correct this statement. Also, please correct the similar statement in the last paragraph of section 4.1.4.1 pg. 134.	The emissions estimates were recalculated to reflect amount of time vessels will be operating with the boundaries of CA Coastal Waters. The revised emissions estimates to not exceed federal thresholds.
APCD Staff recommends that the following measures be applied to the project:					
SB County APCD	Molly Pearson	6	Attachment A	Standard dust mitigations (Attachment A) are recommended for all construction and/or grading activities. The name and telephone number of an on-site contact person must be provided to the APCD prior to the issuance of grading/building permit issuance.	EPM 2.3.5.1 Changed to- "A person or persons would be designated to monitor the dust control program and to order increased watering, as necessary, to prevent transporting dust off-site. The name and telephone number of the dust control monitor would be provided to the SBCAPCD prior to the issuance of grading/building permit issuance."
SB County APCD	Molly Pearson	7		APCD Rule 345, Control of Fugitive Dust from Construction and Demolition Activities establishes limits on the generation of visible fugitive dust emissions at demolition and construction sites. The rule includes measures for minimizing fugitive dust from on-site activities and from trucks moving on and off site. The text of the rule can be viewed on the APCD website at www.ourair.org/wp-content/uploads/rule345.pdf	EPM address Rule 345, additional measures were added to EPM Air Quality as follows: "Outbound trucks hauling construction debris (or any material that would generate visible fugitive dust beyond the property line) would utilize one of the following measures: a. Use properly secured tarps or cargo covering that covers the entire surface area of the load or use a container-type enclosure. b. Maintain a minimum of 6 inches of freeboard below the rim of the truck bed where the load touches the sides of the cargo area and ensure that the peak of the load does not extend above any part of the upper edge of the cargo area. a. Water or otherwise treat the bulk material to minimize loss of material to wind or spillage."
SB County APCD	Molly Pearson	8		The state of California considers particulate matter emitted by diesel engines carcinogenic. Therefore, during project grading, construction, and hauling, construction contracts must specify that contractors shall adhere to the requirements listed in **Attachment B** to reduce emissions of particulate matter from diesel equipment as well as ozone precursors.	These were already inluded in Section 2.3.5.2
SB County APCD	Molly Pearson	9		The proposed project involves operations that are currently subject to APCD permitting requirements, rules, and regulations. Should the project implementation necessitate modifications to the current APCD Permit to Operate, those modifications must be addressed through the APCDs permitting process ***prior to construction of the project*** . The APCD permit process can take several months. To avoid delay, the applicant is encouraged to submit their Authority to Construct permit application to the APCD as soon as possible, see www.ourair.org/permit-applications/ to download the necessary application(s).	Noted.