DRAFT Supplemental Environmental Assessment

Vulcan Centaur Program Operations and Launch from SLC-3E

Vandenberg Space Force Base

Prepared for:

and

Space Launch Delta 30 of the United States Space Force
Vandenberg SFB, CA

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Acronyms and Abbreviations

30 SW	30th Space Wing
AFB	Air Force Base
AFI	Air Force Instruction
Al_2O_3	Aluminum Oxide
AIRFA	American Indian Religious Freedom Act
ALTRV	Altitude Reservation
ARPA	Archaeological Resources Protection Act
ASWS	Acoustic Suppression Water System
B.B.A.	Bachelor of Business Administration
BASH	Bird/Wildlife Aircraft Strike Hazard
BLS	Below Land Surface
BMP	Best Management Practices
BO	Biological Opinion
BRRC	Blue Ridge Research and Consulting, LLC
B.S.	Bachelor of Science
CAA	Clean Air Act
CAAQS	California Ambient Air Quality Standard
C&D	Construction and Demolition Debris
CCAFS	Cape Canaveral Air Force Station
CCC	California Coastal Commission
CCR	California Code of Regulations
CCSFS	Cape Canaveral Space Force Station
CDNL	C-Weighted Day-Night Level
CEIE	Civil, Environmental and Infrastructure Engineering
CEMP	Comprehensive Emergency Management Plan
CEQ	Council on Environmental Quality
CEQA	California Environmental Quality Act
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CES	Civil Engineering Squadron
CFR	Code of Federal Regulations
CH_4	Methane
CO	Carbon Monoxide
CSEL	C-Weighted Sound Exposure Level
CWA	Clean Water Act
CZM	Coastal Zone Management
CZMA	Coastal Zone Management Act
dB	Decibel
dBA	“A-weighted” Logarithmic Scale Decibel

dBC	Decibels Relative to the Carrier Signal
DERP	Defense Environmental Restoration Program
DEX	Duct Exit
DNL	Day-Night Average Noise Level
DoD	Department of Defense
DOT	Department of Transportation
EA	Environmental Assessment
ECP	Entry Control Point
EELV	Evolved Expendable Launch Vehicle
EFH	Essential Fish Habitat
EIAP	Environmental Impact Analysis Process
EIS	Environmental Impact Statement
EISA	Energy Independence and Security Act
EO	Executive Order
EPA	Environmental Protection Agency
EPCRA	Emergency Planning and Community Right-to-Know Act
ERP	Environmental Resource Permits
ESA	Endangered Species Act
ETL	Engineering Technical Letter
EWR	Eastern and Western Range
FAA	Federal Aviation Administration
FEA	Final Environmental Assessment
FEIS	Final Environmental Impact Statement
FLP	Fixed Launch Platform
FONPA	Finding of No Practical Alternative
FONSI	Finding of No Significant Impact
FSEIS	Final Supplemental Environmental Impact Statement
GHG	Greenhouse Gas
GN_2	Gaseous Nitrogen
GSE	Ground Support Equipment
GTO	Geosynchronous Transfer Orbit
H_2O	Water
HABS	Historic American Buildings Survey
HAER	Historic American Engineering Record
HAP	Hazardous Air Pollutant
HAZCOM	Hazardous Communication
HCl	Hydrochloric Acid
HIF	Horizontal Integration Facility
HMTA	Hazardous Materials Transportation Act
ICBM	Intercontinental Ballistic Missile
ICP	Integrated Contingency Plan

ICRMP	Integrated Cultural Resources Management Plan
IIP	Instantaneous Surface Impact Point
IM	Interim Measure
INRMP	Integrated Natural Resources Management Plan
IPA	Isopropyl Alcohol
IPCC	International Panel on Climate Change
IRP	Installation Restoration Program
ITL	Integrate-Transfer-Launch
KSC	Kennedy Space Center
kV	Kilovolt
kVA	Kilovolt Amperes
LAeq	Long-Term Equivalent A-Weighted Sound Level
LC	Launch Complex
LEO	Low Earth Orbit
LH_2	Liquid Hydrogen
LLC	Limited Liability Corporation
LMP	Light Management Plan
LN_2	Liquid Nitrogen
LNG	Liquefied Natural Gas
LO_2	Liquid Oxygen
LSA	Launch Service Agreement
LSB	Launch Service Building
LTDP	Long Term Development Plans
LTM	Long Term Monitoring
LUC	Land Use Control
LUCIP	Land Use Control Implementation Plan
MBTA	Migratory Bird Treaty Act
MGD	Million Gallons per Day
MMPA	Marine Mammal Protection Act
M.S.	Master of Science
MSFCMA	Magnuson-Stevens Fishery Conservation and Management Act
MSL	Mean Sea Level
MST	Mobile Service Tower
MT	Metric Tons
N_2O	Nitrous Oxide
NAAQS	National Ambient Air Quality Standards
NAGPRA	Native American Graves Protection and Repatriation Act
NASA	National Aeronautics and Space Administration
NAVD88	North American Vertical Datum of 1988
NEPA	National Environmental Policy Act
NESHAP	National Emission Standards for Hazardous Air Pollutants

NFPA	National Fire Protection Association
NHPA	National Historic Preservation Act
NMFS	National Marine Fisheries Service
NOA	Notice of Availability
NOAA	National Oceanic and Atmospheric Administration
NOx	Nitrogen Oxides
NPDES	National Pollutant Discharge Elimination System
NRHP	National Register of Historic Places
NRP	NASA Routine Payloads
NSR	New Source Review
NSS	NASA Safety Standard
ODC	Ozone-Depleting Chemical
ODS	Ozone-Depleting Substances
ORV	Off-road Vehicle
OSD	Office of the Secretary of Defense
OSHA	Occupational Safety and Health Administration
PAH	Polynuclear Aromatic Hydrocarbon
PBO	Programmatic Biological Opinion
PCBs	Polychlorinated Biphenyls
PFDP	Preliminary Flight Data Package
PLF	Payload Fairings
PM	Particulate Matter
Ppm	Parts per Million
PTE	Potential to Emit
psf	Pounds Per Square Foot
PSI	Pounds per Square Inch
RCRA	Resource Conservation and Recovery Act
RFI	RCRA Facility Investigation
RMP	Risk Management Plan
ROI	Region of Influence
RP-1	Rocket Propellant 1
SAFMC	South Atlantic Fishery Management Council
SARA	Superfund Amendments and Reauthorization Act
SBCAPCD	Santa Barbara County Air Pollution Control District
SEA	Supplemental Environmental Assessment
SEIS	Supplemental Environmental Impact Statement
SEL	Sound Exposure Level
SFB	Space Force Base
SHPO	State Historic Preservation Office
SLC	Space Launch Complex
SLD 30	Space Launch Delta 30

SLMP	Space Launch Modernization Plan
SO_X	Sulfur Oxide
SO_2	Sulfur Dioxide
SR	State Road
SRM	Solid Rocket Motor
SSA	Space Situational Awareness
SSC	Species of Special Concern
SW	Space Wing
SWI	Space Wing Instruction
SWMU	Solid Waste Management Unit
SWPPP	Stormwater Pollution Prevention Plan
SYBCI	Santa Ynez Band of Chumash Indians
T&E	Threatened and Endangered
THA	Toxic Hazard Assessment
THC	Toxic Hazard Corridors
TNT	Trinitrotoluene
TPY	Tons per Year
TSCA	Toxic Substance Control Act
ULA	United Launch Alliance
US	United States
USC	United States Code
USACE	United States Army Corps of Engineers
USAF	United States Air Force
USFWS	United States Fish and Wildlife Service
USGODMSP	US Government Orbital Debris Mitigation Standard Practices
USSF	UNITED STATES SPACE FORCE
UT	Umbilical Tower
VAFB	Vandenberg Air Force Base
VOC	Volatile Organic Compound
VSFB	Vandenberg Space Force Base
WDR	Wet Dress Rehearsal
WWTP	Wastewater Treatment Plant

1 Introduction: Purpose of and Need for Proposed Action

Space Launch Delta 30 (SLD 30) prepared this Supplemental Environmental Assessment (SEA) to evaluate the impacts associated with United Launch Alliance's (ULA) Vulcan Centaur Space Launch Program (Vulcan Centaur Program) at Vandenberg Space Force Base (VSFB), California. ULA is developing the Vulcan Centaur vehicle to provide a more versatile and cost competitive space launch vehicle while maximizing the use of existing space launch infrastructure and reducing reliance on foreign made goods, specifically the current Atlas V Launch Vehicle Russian-supplied RD-180 engines.

ULA announced the Vulcan Centaur Program in 2015 to reduce cost, increase launch capability and provide the opportunity to partner with companies in the United States (US) to develop rocket engines that eliminate reliance on the current Atlas V Russian-supplied RD-180 engines. The Vulcan Centaur vehicle is designed primarily to meet all current United States Air Force (USAF) and United States Space Force (USSF) Launch Service Agreement (LSA), previously referred to as the Evolved Expendable Launch Vehicle (EELV), requirements and will support National Aeronautics and Space Administration (NASA), Department of Defense (DoD) and commercial payloads. ULA intends to phase out its current Atlas V and Delta IV Programs. ULA's Delta II launch vehicle was retired in 2019.

The Vulcan Centaur vehicle (***Appendix A, Figure 1. Vulcan Centaur Vehicle Configuration***) will contain a larger diameter booster tank than the Atlas V. The first stage will use new BE-4 booster engines that consume liquid oxygen (LO_2) and liquefied natural gas (LNG). Multiple Solid Rocket Motor (SRM) configuration options (zero, two, four or six Orbital ATK GEM-63XL motors) can be specified depending on payload and performance requirements. The Vulcan Centaur first stage will integrate with the Centaur V upper stage, which is similar to but larger than the current Centaur III stage flying on Atlas V.

ULA plans to launch the Vulcan Centaur Vehicle from Space Launch Complex 3 East (SLC-3E) on VSFB and Space Launch Complex 41 (SLC-41) on Kennedy Space Center (KSC) as documented in the *Final Environmental Assessment for the United Launch Alliance Vulcan Centaur Program, Space Launch Complex (SLC) 41, Cape Canaveral Air Force Station (CCAFS), FL*, dated June 12, 2019. This SEA covers the Vulcan Centaur vehicle and launch operations at VSFB only.

At VSFB, Vulcan Centaur Program modifications will occur at SLC-3E and include the addition of a LNG system and modifying the existing LO_2 and liquid hydrogen (LH_2) systems. Modifications to the entry control point (ECP), Mobile Service Tower (MST), Fixed Launch Platform (FLP), umbilical tower (UT), nitrogen purge system, and onsite and offsite roadway infrastructure. Modifications to Solid Motor Building 945 may be required to support contingency short-term storage of SRMs. The SLC-3E Vulcan Centaur Program site plan accommodates the LO_2, $LH_2$and LNG systems within the current SLC-3E perimeter and security fences.

SLC-3E currently supports ULA's Atlas V launches. The Atlas Program was evaluated in the Environmental Impact Statement (EIS) completed in April 1998 *Final Environmental Impact Statement Evolved Expendable Launch Vehicle Program,*[1], hereafter referred to as the 1998 FEIS and incorporated by reference; in the March 2000 *Final Supplemental Environmental Impact Statement (SEIS) for the EELV Program,*[2] hereafter referred to as the 2000 FSEIS and

incorporated by reference; and the November 2003 *Final Environmental Assessment, Atlas V System from SLC-3E,*[3] hereafter referred to as the 2003 FEA. The USSF was the lead agency and the Federal Aviation Administration (FAA) and NASA were cooperating agencies for the 1998 FEIS, 2000 FSEIS and 2003 FEA. The 1998 FEIS covered the development and operations of the Atlas V and Delta IV EELV systems that replaced the Atlas IIA, Delta II and Titan IVB launch systems. The 2000 FSEIS and 2003 FEA listed the USAF as the responsible agency and the FAA and NASA as cooperating agencies. The 2000 FSEIS covered the addition of up to five strap-on SRM on the Atlas V Launch Vehicle and larger SRM on the Delta IV Launch Vehicle.

The FAA formally adopted the 1998 FEIS and 2000 SEIS and issued a Record of Decision to document final approval for issuing, renewing or modifying Launch Operator Licenses for EELV launch vehicles, which included Atlas V at CCAFS. The FAA independently evaluated the information contained in the 1998 FEIS and 2000 SEIS and verified the continued validity of the data and analysis contained in both documents. The FAA found the proposed EIS and SEIS actions were consistent with existing national environmental policies and objectives as set forth in Section 101(a) of the National Environmental Policy Act (NEPA) and approved the Proposed Actions identified.

A Final Environmental Assessment, Atlas V System from SLC-3E, dated November 28, 2003 documented facility, transportation and electrical infrastructure upgrades in support of Atlas V operations.

Separate but related, the USAF issued a Finding of No Significant Impact (FONSI) on June 24, 2019 based on the findings in the *Final Environmental Assessment for the United Launch Alliance Vulcan Centaur Program, Space Launch Complex (SLC) 41, Cape Canaveral Air Force Station (CCAFS), FL*, dated June 12, 2019. The FAA was a cooperating agency in the preparation of this 2019 EA and issued its own FONSI on February 27, 2020 to support issuing licenses to ULA for Vulcan Centaur launch operations at LC-41.

This SEA has been prepared in accordance with the requirements of NEPA of 1969 (42 United States Code [USC.] §4321 et seq.); the Council on Environmental Quality (CEQ) Regulations for Implementing the Procedural Provisions of NEPA (40 Code of Federal Regulations [CFR] Parts 1500-1508), dated 1986; USAF Environmental Impact Analysis Process (EIAP) (32 CFR Part 989); *DoD Instruction 4715.05, Environmental Compliance of Installations Outside the United States*; *Executive Order 12114 Environmental Effects Abroad of Major Federal Actions*; and FAA Order 1050.1F, *Environmental Impacts: Policies and Procedures*.

Pursuant to agreements between the USAF, USSF, NASA and FAA, the USSF is the lead agency for the preparation and coordination of the EA (40 C.F.R. § 1501.7) and the FAA and NASA are acting as cooperating agencies (40 C.F.R. § 1501.8). The USSF owns the real property where Vulcan Centaur Program operations will occur and is responsible for reviewing, providing input and approving the construction/site modifications addressed in this SEA. Both the USSF and NASA use LSA for access to space for their payloads. The FAA's role is licensing commercial space launch operations and approving airspace closures for launch operations. ULA will be required to obtain a license from the FAA prior to conducting launches from SLC-3E with commercial payloads. The FAA has no action related to the modifications and additions to Site SLC-3E. Additional details on FAA requirements are contained in Section 1.4.1, *Lead and Cooperating Agency Actions*.

1.1 Background

The Commercial Space Launch Act Amendments of 1988 (Public Law 100-657) amended the Commercial Space Launch Act of 1984 (Public Law 98-575), which "directs the Secretary of Transportation, in facilitating and encouraging private sector acquisition of US surplus launch property, to take into account the availability of comparable property under reasonable terms from domestic non-Government sources.[4]" The Amendments of 1988 direct the Administrator of NASA to: "(1) design a program to support research into launch systems component technologies to develop higher performance and lower costs for commercial and Government launches; and (2) report to the Congress outlining the program.[5]"

Recognizing that space transportation costs must be significantly reduced to make continued exploration, development and use of space sustainable given budgetary constraints, the US Government developed the National Space Policy of June 28, 2010. A policy principle is a commitment to encourage and facilitate the growth of a US commercial space sector. Key elements of the commercial aspects of the National Space Policy include:

- "The United States is committed to a robust and competitive industrial base. In support of its critical domestic aerospace industry, the US Government will use commercial space products and services in fulfilling governmental needs, invest in new and advanced technologies and concepts, and use a broad array of partnerships with industry to promote innovation. The US Government will actively promote the purchase and use of US commercial space goods and services within international cooperative agreements.[6]"

"The United States will advance a bold new approach to space exploration. The National Aeronautics and Space Administration will engage in a program of human and robotic exploration of the solar system, develop new and transformative technologies for more affordable human exploration beyond the Earth, seek partnerships with the private sector to enable commercial spaceflight capabilities for the transport of crew and cargo to and from the International Space Station, and begin human missions to new destinations by 2025.[7]"

In 1994, Congress passed legislation that was the impetus for a major study accomplished by the DoD. This study became the basis for a clearly defined national course of action undertaken to significantly reduce the cost of space launches. The Fiscal Year 1994, National Defense Authorization Act, P.L. 103-160, Section 213 (a),[8] in part, read:

> "The Secretary of Defense shall develop a plan that establishes and clearly defines priorities, goals, and milestones regarding modernization of space launch capabilities for the Department of Defense or, if appropriate, for the government as a whole."

In response to the law, the Air Force was tasked to produce the plan, known as the Space Launch Modernization Plan (SLMP) April 1994.[9] As a result of the SLMP, the Office of the Secretary of Defense (OSD) and the Administration selected two alternatives for further development:

- NASA would oversee the development of a new reusable space launch system in coordination with the DoD.
- USSF, as executive agent for space launch for the DoD, would develop an EELV program.

President Donald Trump defined the America First National Space Strategy (Fact Sheet issued March 23, 2018).[10] Elements of this strategy key to the Vulcan Centaur Program include:

- "The United States will partner with the commercial sector to ensure that American companies remain world leaders in space technology."
- "The new strategy ensures that international agreements put the interests of American people, workers, and businesses first."

The Vulcan Centaur Program was developed to support the US Government and commercial space exploration development and use with the guidance of the Commercial Space Launch Act and its Amendments. ULA's Vulcan Centaur vehicle offers a more versatile, cost competitive launch vehicle and reduces reliance on foreign made goods, specifically the current Russian RD-180 engines.

The first planned launch of the Vulcan Centaur is in 2023. Existing SLC-3E systems and infrastructure at VSFB would be modified for Vulcan Centaur but would remain substantially consistent with current launch operations.

SLC-3E is ULA's primary pad for Atlas V missions on the West coast. The complex began service in 1961 as a Missile Defense Alarm System (MIDAS) launch pad. After the MIDAS program was terminated, SLC-3E was used for Project PRIME. The pad served Atlas as well as the Atlas-Agena missions following PRIME. The 33-acre property supported the Thor-Agena launches from 1963 to 1972 and the Atlas E/F missions from 1972 to 1995. The adjacent, SLC-3W is immediately northwest of SLC-3E. It was primarily used for the Atlas-Agena launches before transitioning to the Corona program with Thor-Agena rockets in 1962. After the end of the Corona missions, the pad was used for Atlas E/F rockets, becoming inactive after the final launch in 1995.

1.2 Project Location

VSFB, under the command of the 30 SW is located in Santa Barbara County on the California south-central coastline. The base is approximately 150 miles northwest of Los Angeles and equidistant between San Diego and San Francisco. VSFB encompasses an area of more than 99,000 acres with over 42 miles of coastline to the Pacific. The base is located at 34.7420 latitude N and 120.5724 longitude W.

VSFB is a key asset in its ability to launch and track satellites in space, monitor and test intercontinental ballistic missiles, and send space vehicles into a polar orbit. The bordering city, Lompoc, is approximately 6.3 miles to the east, separated by agricultural land use. SLC-3E is approximately 2.4 miles from the VSFB boundary, as shown in ***Appendix A, Figure 2. Vicinity Map*** and ***Appendix A, Figure 3. Location Map***. The western border of SLC-3E is approximately 1.75 miles from the Pacific Coast and 1.5 miles from SLC-4. SLC-3 is comprised of two launch complexes, SLC-3E (active) and SLC-3W (inactive). The South VSFB Harbor and Dock is located southwest of SLC-3E and provides capabilities for a variety of marine vessels transporting rocket components. This includes ULA's Delta Mariner vessel, which was recently re-christened and hereafter referred to as Rocketship. An auxiliary Spacecraft Processing Facility manages Spacecraft and fairing acquisition, and Building 8510 Remote Launch Control Center handles Vehicle and Ground Support Equipment (GSE) Command and Control, Telemetry Collection, and Engineering Support.

1.3 Purpose of and Need for Proposed Action

The purpose of ULA's Proposed Action is to provide a versatile, cost competitive launch vehicle that meets all current USAF and USSF LSA requirements to provide medium (2,500 to 17,000 pounds) and heavy (13,500 to 41,000 pounds) payload lift capability for Government space launches at lower recurring costs than current ULA expendable systems. The ULA Vulcan Centaur maximizes use of existing space launch infrastructure, provides the USSF with additional lift capability and eliminates reliance on the current Atlas V RD-180 Russian-supplied engines. The Vulcan Centaur Program will support the Commercial Space Launch Act and its Amendments and both manned and unmanned NASA, DoD and commercial payloads.

The Proposed Action allows continued fulfillment of the National Space Policy to actively promote the purchase and use of US commercial space goods and services and reduce space transportation costs as well as eliminating use of Russian-supplied engines. ULA believes that its launch service is needed to address the demand for cost-competitive commercial launch vehicles to ensure US space launch capability is not reduced or limited.

1.4 Scope of the Supplemental Environmental Assessment

This SEA evaluates the potential site-specific environmental consequences associated with Vulcan Centaur Program and operations at VSFB as a supplement to the 2003 EA. The scope includes evaluating the environmental impacts of the Vulcan Centaur Program from receipt of vehicle components from the Rocketship vessel at the South VSFB Harbor and Dock, vehicle component transportation and vehicle preparation, launch preparation, payload considerations and final launch from SLC-3E. No vehicle component reuse is included; the Vulcan Centaur Program is completely expendable. Because all of these operations are similar to current Atlas V operations covered under existing 1998 FEIS, 2000 FSEIS and 2003 FEA actions, this SEA will focus on the modifications or changes required by the Vulcan Centaur Program as described in Section 2.1, Vulcan Centaur vehicle and Section 2.2, Facility Modifications.

1.4.1 Lead and Cooperating Agency Actions

This ULA Vulcan Centaur Program SEA was developed with the USSF as the responsible agency and the FAA and NASA as cooperating agencies.

The USSF is the lead agency since the Action is directly related to ULA's obligations under the USAF and USSF's LSA Program. Additionally, the USSF is the lease and license holder for the real property and is responsible for approving the construction and site modifications where the Action will occur. If, after the public's review of the SEA, the USSF determines that the Proposed Action would not individually or cumulatively result in significant impacts on the human or natural environments, the USSF would issue a final Finding of No Significant Impact (FONSI) and real property modifications would proceed.

The FAA is a cooperating agency because of its role in licensing commercial space launch operations in the US and approving airspace closures for launch operations. The FAA expects to receive a launch license application(s) from ULA for Vulcan Centaur operations at SLC-3E. If, after reviewing the launch license application and this SEA, the FAA determines that ULA's proposed operations fall within the scope of this SEA and that the FAA's action of issuing a launch license to ULA for Vulcan Centaur operations at SLC-3E would not result in significant

impacts on the human or natural environment, the FAA would adopt this SEA and issue its own FONSI to support issuing a launch license to ULA for Vulcan Centaur (commercial customer flights). The FAA will draw its own conclusions from the analysis presented in this SEA and assume responsibility for its environmental decision and any related mitigation measures. For the FAA to completely rely on this SEA to satisfy its NEPA obligations, the SEA must meet the requirements of FAA Order 1050.1F, which contains the FAA's policies and procedures for compliance with NEPA.

USSF owns SLC-3E and leases the property to ULA for use through December 31, 2021 with the intent to renew the lease. The Proposed Action would support the Commercial Space Launch Act and its Amendments and launches of NASA payloads.

1.4.2 SEA Structure

Section 1 of this SEA contains an introduction to the Vulcan Centaur Program and the scope of the proposed action. Section 2 of this SEA describes the Proposed Action, No Action Alternative and alternatives dismissed from detailed analysis in this SEA. Section 3 describes the 16 environmental aspects identified for analysis: Land Use / Visual Resources, Noise, Biological Resources, Historical and Cultural Resources, Air Quality, Climate, Orbital and De-Orbiting Debris, Hazardous Materials and Solid and Hazardous Waste, Water Resources, Geology and Soils, Transportation, Utilities, Health and Safety, Socioeconomics, Environmental Justice and Department of Transportation Act Section 4(f) Properties. Section 4 describes the potential impacts associated with each of the 16 environmental aspects under the Proposed Action and the No Action Alternative. Section 4.16 summarizes the impacts in each environmental aspect area, and Section 5 describes cumulative environmental impacts.

This SEA was produced using available Vulcan Centaur Program Launch Vehicle and VSFB launch operations information. All applicable environmental data necessary was collected to describe current environmental conditions.

2 Description of the Proposed Action and Alternatives

This section describes the Proposed Action, location for Vulcan Centaur Program operations and the No Action Alternative. The Vulcan Centaur Program was announced in 2015 and is anticipated to significantly reduce costs while increasing overall capabilities. The first planned launch of the Vulcan Centaur Launch Vehicle is in 2023. The Proposed Action includes modifications (construction) to Site SLC-3E described in Section 2.1. Section 2.9 describes the Alternatives Considered but Eliminated from Further Study and provides the rationale for their elimination.

2.1 Facility Modifications

Modifications will occur at SLC-3E and include the addition of a LNG system and modifying the existing LO_2, LH_2, gaseous nitrogen (GN_2) and acoustic suppression water system (ASWS). Reference ***Appendix A, Figure 4. Vulcan Centaur SLC-3E Site Modifications*** for an overview of existing and proposed infrastructure at SLC-3E. Modifications to the ECP, MST, FLP, UT services, nitrogen purge system, and onsite and offsite roadway infrastructure. Modifications to Solid Motor Building 945 may be required to support contingency short-term storage area of SRMs. These modifications include:

- SLC-3E Commodities – Existing LO_2, LH_2 and ASWS will be modified and a LNG system will be added, to include:
    1. Installing a new LNG system with one new 250,000-gallon storage sphere, four new vaporizers, one new knock-down vessel, one new enclosed flare stack, two new elevated flare stacks, two filling stations, cross-country piping and impoundment basin to support the Vulcan Centaur first stage. One existing 44,000-gallon LO2 vessels that currently support Atlas V booster will be repurposed as a LN_2 (cooling) vessel.
    2. Replacing the existing 33,000-gallon LH_2 vessel with two new 67,000-gallon LH_2 vessels and associated piping, one new vaporizer, reuse of the one existing fill station, replacing the existing LH_2 storage tank flare stack, and modifying the existing UT hydrogen vent to support the new Centaur upper stage.
    3. Installing one new 250,000-gallon LO_2 sphere, up to four new vaporizers, retain three existing fill stations and repurpose associated piping to support the new Vulcan Centaur booster. Two existing 44,000-gallon LO_2 vessels that currently support Atlas V booster will be repurposed for the Vulcan Centaur LO_2 system.
    4. Removing the existing FLP ASWS vessels and installing new ASWS vessel(s) in the existing RP-1 storage area.
    5. Installing a new GN_2 (World Purge) nitrogen purge system in the existing RP-1 storage area to purge the FLP area with nitrogen prior to engine start.
- SLC-3E MST – The existing MST will remain and be modified as follows: The 60-Ton crane will be upgraded to 65-Ton capacity and increase crane trolley travel distance (east-west) and hook height. Platforms no longer required will be removed. New mechanical work platforms will be designed, fabricated and installed. The MST door structure and door controls will be designed and modified to accommodate the larger vehicle, SRMs and FLP.

- SLC-3E FLP – Design and construct a new FLP and mast to support Vulcan Centaur booster fuel and oxidizer loading operations and ground wind damper. The existing ASWS will be relocated from the FLP to the existing RP-1 storage area.
- Solid Motor Building 945 – For contingency SRM storage, modifications to the exterior ground system, perimeter fence and asphalt storage pad are required.
- Roadway Modifications – The following roadway modification locations are anticipated based on the larger Vulcan Centaur vehicle:
    1. Intersection of Luner Road and Coast Road
    2. Intersection of Coast Road and Bear Creek Road
    3. Intersection of Bear Creek Road and Napa Road
    4. SLC-3E main entrance road (Napa Road extension)
    5. Intersection of Utah Avenue and 10th Street

These modifications and new program elements are described below and will not interfere with existing Atlas V operations or launch manifests.

2.1.1 Proposed Changes to SLC-3E

2.1.1.1 Liquefied Natural Gas (LNG) System

The Vulcan Centaur LNG system is a new installation at SLC-3E built to support the Vulcan Centaur Program. All major components and supporting infrastructure are new.

Two drive-through filling stations will be constructed to offload LNG from tankers to the LNG storage area and accessible from the existing northeast pad entrance road. The filling stations will be designed to safely and adequately collect boil off and burn natural gas through enclosed flare.

The LNG Storage Area will consist of one 250,000-gallon vacuum-jacketed LNG storage sphere, one LNG recovery vessel (flare liquid knock-down tank), four LNG vaporizers, one LN_2 vessel for LNG sphere cooling, a system control panel, various piping, valves, and access platforms. All the storage area components will be contained in a concrete equipment yard and will capture and direct an accidental LNG leak to an earthen impoundment basin, located away from the storage area along the northwest fence line.

The impoundment basin will be designed to contain the design spill source as determined by National Fire Protection Association (NFPA) under NFPA 59A, Table 5.3.3.7 for an accidental leak and is connected to the LNG Storage Area through a sloped impoundment trench.

Three new natural gas flares will be located along the west side of the pad deck backup ramp. Two elevated utility flare stacks will be used for launch day activity. The third will be an enclosed flare stack used for burning natural gas from tanker offload operations or LNG sphere if the LN_2 cooling loop cannot maintain the desired sphere pressure.

One vacuum-jacketed cross-country line (the LNG Transfer and Drain Line) will run from the LNG storage area, along the west access road, through the existing RP-1 area and into the Launch Service Building (LSB) Room 215. Inside LSB Room 215 the LNG Transfer and Drain Line will be managed by flow control, relief and manual valves, and a system control panel.

One vent line will be constructed to run from the top of the vehicle LNG tank to FLP/Mast vent pipe, to the flare liquid knock down tank prior to burning through the Vehicle elevated flare

stack. A second vent line will be constructed to collect engine bleed and other ground system vents, routed to flare liquid knock down tank, prior to burning through second elevated GSE flare.

2.1.1.2 Centaur Liquid Hydrogen System Modifications

Two new LH_2 vessels (approximately 67,000-gallon and 45,000-gallon) will replace the existing 33,000-gallon Centaur LH_2 vessel in the same location on the west side of the launch complex (LC). The existing LH_2 vessel will be drained and taken off-line prior to removal. To accommodate the two new LH_2 vessel, a new concrete equipment pad will be constructed immediately west of the existing LH_2 concrete pad, and the existing LH_2 equipment pad will be extended north.

The foundation will be designed based on vessel manufacturer's design loads and the geometry of the new tank. The topography at SLC-3E, along the western boundary, provides a natural berm to provide appropriate separation from LO_2 stored on the east side of SLC-3E. An earthen berm retention wall along the west LSB access road and parallel to the LH_2 vessel will be constructed to ensure appropriate line of sight protection to the east pad LO_2 storage area. The existing tanker off-load station will be repurposed to support the new Centaur LH_2 system. The stormwater management system will be revised to meet code for the added impervious surface. Foundations and steel supports will be modified and repurposed as required for the cross-country piping and conduit between the new LH_2 vessel and the pad deck/UT. The existing Centaur LH_2 vacuum-jacketed piping and vent system will be reused for the Vulcan Centaur Program.

2.1.1.3 Centaur Liquid Oxygen (LO_2) System Modifications

The Vulcan Centaur Program will require the addition of one new 250,000-gallon LO_2 sphere for the new Vulcan Centaur booster in addition to re-purposing two existing 44,000-gallon Atlas V booster LO_2 vessels and four existing vaporizers for the Vulcan Centaur LO_2 system. The repurposed Centaur LO_2 vessels, vaporizers and up to four new vaporizers will be added to support new LO_2 sphere. Three existing filling stations will be repurposed to serve the Centaur and Booster LO_2 filling operation. The new sphere and vaporizers will require new concrete equipment pads with curbing. The new vaporizers will be installed in the existing vaporizer equipment area. The existing LO_2 vessels and associated equipment pad will be repurposed and integrated into the new equipment area. New transfer lines will be added and routed to the existing trench to the LSB and UT with new foundations and supports as required.

2.1.1.4 Acoustic Suppression Water System Modifications

The ASWS continues to support the Atlas V program in addition to meeting the new, extended duration, requirements of the Vulcan Centaur Program.

The new ASWS vessel will be installed in the existing RP-1 storage area with new foundations and new water lines routed to the FLP nozzles. The new ASWS vessel will connect to the new co-located GN_2 service.

2.1.1.5 Mobile Service Tower

MST modifications in support of the Vulcan Centaur Program include upgrading the bridge crane from 60 to 65-tons; increasing the east-west trolley travel distance, approximately 24-inches in each direction; and increasing the hook height to support larger Vulcan Centaur. The MST interior platforms and exterior doors require modifications to accommodate the larger Vulcan Centaur vehicle. The existing MST mechanical work platforms will be removed if no longer required to support Vulcan Centaur vehicle access.

2.1.1.6 Fixed Launch Platform

A new larger FLP will be required to support the heavier Vulcan Centaur vehicle. The FLP will incorporate a new mast to support booster fill and drain, umbilicals and ground wind damper. The FLP will be constructed offsite in several sections and then assembled on location. A new Mast will also be added on FLP to support booster fuel, oxidizer and ground control interface connections. In addition, ULA will modify the UT to accommodate new vehicle interface locations and a larger diameter hydrogen vent.

2.1.2 Proposed Changes to Support Facilities

2.1.2.1 Solid Motor Building

Solid Motor Building 945 will be modified for contingency SRM storage. Modifications include extending east side fence line, access gate, and asphalt pad to accommodate up to six each GEM 63XL. Zero (0), One, or two SRM may be temporarily stored within the interior of Building 945. Minor modifications to the existing grounding grid are required to support contingency SRM storage. Lightning protection will be satisfied by the transportation trailer and the existing Building 945 grounding grid.

2.1.2.2 Roadway Modifications

Roadway Modifications are anticipated based on a larger Vulcan Centaur vehicle.

2.1.2.2.1 Intersection of Luner Road and Coast Road

A larger turning radius is required for the southwest corner of the Coast Road and Luner Road intersection. Additionally, the Luner Road pavement width will increase for approximately 200 linear feet from the Coast Road intersection. Reference ***Appendix A, Figure 5. Luner Road and Coast Road Intersection Modifications***.

2.1.2.2.2 Intersection of Coast Road and Bear Creek Road

The Bear Creek Road pavement width will increase for approximately 200 linear feet from the Coast Road intersection. Reference ***Appendix A, Figure 6. Coast Road and Bear Creek Road Intersection Modifications***.

2.1.2.2.3 Intersection of Bear Creek Road and Napa Road

A larger turning radius is required for the southwest corner of the Bear Creek Road and Napa Road intersection. Additionally, the Bear Creek Road pavement width will increase for approximately 200 linear feet from the Napa Road intersection. Reference ***Appendix A, Figure 7. Bear Creek Road and Napa Road Intersection Modifications***.

2.1.2.2.4 SLC-3E Entry Control Point

The main entrance road at SLC-3E requires modifications to widen the existing main entrance from Napa Road to the ECP; enlarging the turning radii; and replacing the vehicle gate. Reference ***Appendix A, Figure 8. Entry Control Point Modifications***.

2.1.2.2.5 Intersection of Utah Avenue and 10th Street

The south shoulder of Utah Avenue requires widening from the 10th Street intersection, east approximately 400 linear feet, to the Building 7525 entrance road. A new parking and storage area is proposed, immediately east of the existing Building 7525 entrance road, just south of Utah Avenue. Reference ***Appendix A, Figure 9. Utah Avenue and 10th Street Intersection Modifications***.

2.2 Launch Operations

2.2.1 Launch Vehicle Components

Vulcan Centaur vehicle components, manufactured at ULA's Facility in Decatur, Alabama and shipped aboard the Rocketship cargo vessel, will be received at the VSFB Harbor. Components are transferred via truck over VSFB roads to the SLC-6 Horizontal Integration Facility (HIF) Receiving and Inspection facility. This includes the Centaur Interstage Adapter, Payload Attached Fitting, Vulcan Centaur Booster as well as the payload fairings. From the HIF, the vehicle components are transported by truck over VSFB roads to SLC-3E and assembled vertically within the MST. The transportation routes used for Vulcan Centaur vehicle components are identical to the Atlas V routes from the South VSFB Harbor and Dock. The weight of Vulcan Centaur components will increase compared to Atlas V, but still meet standard Department of Transportation (DOT) requirements for axle loading.

2.2.2 Manpower

Vulcan Centaur Program operations personnel levels are expected to remain the same or slightly reduce from the existing Atlas V operations, which is approximately 200 people.

2.2.3 Safety Systems

The ULAVAFB-OSP-001 provides ULA's operational safety plan approved by SLD 30. This document will be updated for the Vulcan Centaur Program and specifically address LNG hazard mitigation. The Eastern and Western Range (EWR), UNITED STATES SPACE FORCE COMMAND MANUAL 91-710 , Range Safety Requirements and Air Force Manual (AFMAN) 91-201 (tailored for Vulcan Centaur) outlines the process for reviewing and approving launch facility design and construction at SLC-3E.

2.3 Vulcan Centaur Vehicle

The Vulcan Centaur vehicle will have a gross lift-off mass of approximately 450 to 780 tons and produce approximately 1.1-3.5 million pounds of thrust. The vehicle's overall liftoff height is 199.8 feet with a diameter of 17.7 feet. The Vulcan Centaur first stage will integrate with the Centaur V upper stage which is similar to, but larger than the current Centaur III stage flying on Atlas V.

The Vulcan Centaur vehicle will contain a larger diameter booster tank than the Atlas V. The first stage will use two BE-4 booster engines. A single BE-4 engine consumes approximately 150,000 pounds (68,038 kilograms) of LNG and 500,000 pounds (226,796 kilograms) of LO_2. Multiple SRM configuration options in zero, two, four or six Orbital ATK GEM-63XL engines can be specified depending on payload and performance requirements. The Centaur second stage will have two RL10 LO_2/LH_2 engines.

2.3.1 Ground Support Operations

Vulcan Centaur ground support operations and vehicle processing will be similar to Atlas V operations with emphasis on reduced horizontal processing. The SLC-6 HIF will support Vulcan Centaur component receipt, initial and ongoing storage inspection, shape charge installation and readiness review for transport from HIF to SLC-3E for vertical assembly.

Vulcan Centaur processing is performed vertically in the SLC-3E MST. Depending on customer requirements, a Wet Dress Rehearsal (WDR) is performed prior to stacking encapsulated fairing or spacecraft. Upon completion of vertical testing and WDR, the encapsulated fairing is vertically stacked and inspected to support final launch preparations and closeouts.

Upon the completion of successful launch site testing and in coordination with space vehicle orbital launch window/time requirements, the launch site is configured for launch and terminal launch countdown is initiated. Personnel are cleared from SLC-3E launch site and appropriate VSFB evacuation is initiated. Once area is confirmed clear of personnel, cryogenic fuel and oxidizer is loaded onto Vulcan Centaur vehicle, and the launch countdown continues through Vulcan Centaur Booster engine start and lift off.

Immediately following Vulcan Centaur lift off, the fuel and oxidizer systems are remotely de-pressurized and secured. Following remote securing, a limited re-entry crew, along with Base Fire, performs final system securing and safing of SLC-3E in preparation for re-entry of essential personnel.

2.4 Airspace

All launch operations would continue to comply with the necessary notification requirements, including issuance of Notices to Airmen (NOTAMs) and Local Notices to Mariners (NOTMARs), consistent with current procedures. A NOTAM provides notice of unanticipated or temporary changes to components of, or hazards in, the National Airspace System (FAA Order JO 7930.2S, Notices to Airmen). A NOTMAR provides notice of temporary changes in conditions or hazards in navigable waterways. Western Range operations (which include the proposed launches from SLC-3E) currently follow the procedures stated in a Letter of Agreement (LOA) (dated April 7, 2020), ***Appendix B*** between SLD 30 and FAA. The LOA

establishes responsibilities and describes procedures for SLD 30, Western Range Operations, within airspace common to the Oakland Air Route Traffic Control Center (ZOA), Los Angeles Air Route Traffic Control Center (ZLA), Santa Barbara Terminal Radar Approach Control Facility (SBA), Fleet Area Control and Surveillance Facility (FACSFAC), Air Traffic Control System Command Center, Pacific Military Altitude Reservation Function (PACMARF) and Central Altitude Reservation Function (CARF) areas of jurisdiction. The LOA defines responsibilities and procedures applicable to operations, which require the use of Restricted Areas, Warning Areas, Air Traffic Controlled Assigned Airspace, and/or altitude reservations within Western Range airspace.

The Proposed Action does not include altering the dimensions (shape and altitude) of the airspace. However, temporary closures of existing airspace issued by the FAA's Air Traffic Organization are Federal actions connected to the Proposed Action and thus analyzed in this SEA. Advance notice via NOTAMs would assist pilots in scheduling around any temporary disruption of flight activities in the area of operation. Launches would be of short duration and scheduled in advance to minimize interruption to airspace.

2.5 Launch Trajectories

Vulcan Centaur vehicle trajectories are specific to each mission and are similar to current Atlas V trajectories as described in ULA's FAA Commercial Space Transportation License application (License # LLO 18-113). Flight trajectories vary based on mission specifics such as payload, desired orbit (height, eccentricity) and engine configuration. Nominal Vulcan Centaur trajectories will be southward over the Pacific Ocean and will be similar to the launch azimuths permitted for Atlas V, respectively inclusive between 150 and 270 degrees.

2.6 Payloads

Vulcan Centaur Program payloads will be similar to current and planned payloads launched on Atlas V as well as capable of lifting heavy payloads currently supported by Delta IV vehicle at SLC-6.

In November 2011, NASA prepared an EA for *Launch of NASA Routine Payloads on Expendable Launch Vehicles.*[11] The abstract from this document verifies that no new or substantial environmental impacts or hazards were identified:

> "This Final Environmental Assessment updates the Final Environmental Assessment for Launch of NASA Routine Payloads on Expendable Launch Vehicles from Cape Canaveral Space Force Station, Florida and VSFB, California (June 2002) and addresses NASA's proposed action to launch a variety of spacecraft missions. The spacecraft used in these missions are considered routine payloads; the same threshold quantities and characteristics describe them all, and they would present no new or substantial environmental impacts or hazards as compared to previously analyzed and documented impacts. These scientific and technology demonstration missions are needed for US space and Earth exploration. All spacecraft (referred to as NASA routine payloads (NRP)) examined in this environmental assessment would meet rigorously defined criteria to ensure that the spacecraft and their launch and operation would not present any new or substantial environmental or safety concerns. The NRPs would launch from existing launch facilities (or those currently under construction) at CCAFS, Florida;

> VSFB, California; the Ronald Reagan Ballistic Missile Defense Test Site at US Army Kwajalein Atoll in the Republic of the Marshall Islands; NASA Wallops Flight Facility, Virginia; and Kodiak LC, Alaska. National Environmental Policy Act documentation exists that analyze the potential environmental impacts at each of these launch sites for the evaluated launch vehicles."

This SEA compares the anticipated Vulcan Centaur payloads to the current Atlas V routine payloads as documented in the November 2011 *Environmental Assessment for Launch of NASA Routine Payload.*[12] The analysis determined that the anticipated Vulcan Centaur payloads are within the scope of the 2011 NASA Routine Payload EA and are therefore categorically excluded from this NEPA evaluation. If future, unanalyzed payloads or vehicle configurations pose potential environmental consequences, separate NEPA evaluation(s) will be performed for each unique payload program or launch vehicle configuration, as required.

2.7 Projected Launch Schedule

The first Vulcan Centaur Program launch from SLC-3E is anticipated in late-2023, with anticipated maximum annual launch rates of six per year (see ***Table 2-1: Planned and Projected ULA Vehicle Launches at VSFB***), including day and nighttime (10:00 PM to 7:00 AM) periods. As shown in ***Table 2-1***, Atlas V launches would continue until 2022. After 2022, the Atlas V Program would be phased out completely, and only Vulcan Centaur launches would occur from SLC-3E. ***Table 2-1*** shows the preliminary Vulcan Centaur annual launch forecast. For purposes of environmental analysis, a maximum launch rate of six Vulcan Centaur launches per year from VSFB is used.

Table 2-1: Planned and Projected ULA Vehicle Launches at VSFB

Year	ULA Project Launches		
	Delta IV (SLC-6)	Vulcan Centaur (SLC-3E)	Atlas V (SLC-3E)
2020			
2021	1		1
2022	1		1
2023		1	
2024		2	
2025		3	
2026		3	
2027		3	
Note: Launch projections greater than two years out are very subjective.			

2.8 No Action Alternative

Under the No Action alternative, ULA would retain its current Atlas V and Delta IV capabilities to launch payloads into space. ULA would be at a competitive cost disadvantage to other commercial launch vehicles. Under the No Action Alternative, ULA would not apply to the FAA or USSF for a commercial space launch license for the Vulcan Centaur for operations at SLC-3E.

Atlas V launches would still rely on Russian-made RD-180 engines, which could become increasingly difficult to procure, endangering Atlas V's longevity and potentially reducing or limiting US space launch capability and assured access to space.

SLC-3E would continue to be used to launch Atlas V 400 and 500 variants, with a standard common core booster powered by the LO_2-kerosene RP-1, RD-180 engines, up to four strap-on Aerojet SRMs, a Centaur upper stage in a single- or dual-engine configuration, and one four or five meter diameter payload fairing. The Centaur would be powered by the existing Aerojet Rocketdyne RL10C-1 engines.

2.9 Alternatives Considered but Eliminated from Further Study

After ULA determined the need to field a new launch system to replace the current capabilities of Atlas V and Delta IV, ULA considered many alternatives for launch vehicle design and launch sites. Per Title 32 CFR Part 989.8, alternatives were evaluated for reasonableness using the following selection criteria:

1. Fully support the purpose and proposed need (specifically to provide medium and heavy lift capability, maximize use of existing space launch infrastructure and eliminate reliance on the current RD-180 Russian-supplied engines).
2. Ensure safe launch trajectories that minimize risk to the public.
3. Reduce recurring costs with respect to current ULA expendable systems.
4. Minimize capital expense.
5. Support a development and construction schedule to meet late-2023 first Vulcan Centaur launch.
6. Engage an available, high quality workforce.

From a launch vehicle perspective, a broad survey of available and in-development booster engines was considered. These engines used either LNG or RP-1 for fuel. The LNG BE-4 engine was selected as it was the only engine identified that could provide medium and heavy lift capability, eliminate reliance on the current RD-180 Russian-supplied engines and support a development schedule to meet a late-2023 first Vulcan Centaur launch at VSFB.

LNG fuel volume drives the size of the booster due to fuel density and performance required to lift the vehicle into desired orbits. With the booster generally sized, launch sites capable of accommodating the Vulcan Centaur Program were considered. Current ULA facilities (SLC-3E and SLC-6) were considered as well as existing, no-longer operational launch sites at VSFB. Sites outside the continental US were also considered. Sites outside the continental US were eliminated because they did not maximize use of existing space launch infrastructure, ensure reduction in recurring costs, minimize capital expense, support a late-2023 launch construction schedule and ensure an available, high quality workforce.

Existing, no-longer operational launch sites at VSFB were evaluated, but no such sites that can support medium and heavy launch vehicles are available for development.

2.10 Preferred Alternative

The BE-4 engine was selected as the Preferred Alternative because it was the only engine identified that could provide medium and heavy lift capability, eliminate reliance on the current

RD-180 Russian-supplied engines and support a development schedule to meet a late-2023 first Vulcan Centaur launch.

Modifying SLC-3E, constructing a new FLP and modifying the MST to accommodate Vulcan Centaur, while maintaining Atlas V capability, was determined to be ULA's Preferred Alternative for the launch site because:

1. SLC-3E supports medium and heavy lift capability and maximizes use of existing space launch infrastructure, requiring minor modifications to pad systems. New LNG capability would be required at all launch site alternatives.
2. SLC-3E is configured for vertical integration, which is the preferred integration method for the AF and other customers.
3. SLC-3E and HIF infrastructure and modifications minimize capital expense.
4. The SLC-3E construction schedule is able to meet a late-2023 first Vulcan Centaur launch.
5. Vulcan Centaur operations are very similar to current Atlas V Centaur operations and take advantage of the Atlas V high quality, available workforce.

The Proposed Action is then the Preferred Alternative.

3 Affected Environment

In compliance with NEPA and CEQ guidelines, this Section describes the existing environment for the Proposed Action and No Action Alternative.

Fifteen (15) environmental aspects are identified for analysis: Biological Resources, Air Quality, Historical and Cultural Resources, Water Resources, Hazardous Materials and Solid and Hazardous Waste, Health and Safety, Land Use, Noise, Environmental Justice, Orbital and De-Orbiting Debris, Geology and Soils, Transportation, Utilities, Department of Transportation Act Section 4(f) Properties and Socioeconomics. For each resource area, a region of influence (ROI) is established that defines an area where the Federal action, program or activity may cause an impact. In general, the ROI for this assessment is SLC-3E, VSFB, and the general Northern Santa Barbara County, primarily the cities of Lompoc and Santa Maria.

As stated in Section 1, this SEA complies with FAA Order 1050.1F (the FAA's NEPA-implementing policies and procedures) so the FAA can easily adopt this SEA and issue its own FONSI, if applicable. FAA Order 1050.1F, Paragraph 4-1, lists environmental impact categories (i.e., resource areas) for which the FAA considers in its NEPA documents. This SEA analyzes all of the FAA's environmental impact categories except farmlands, children's environmental health and safety risks, natural resources, and wild and scenic rivers for the following reasons:

- **Farmlands**. The Proposed Action would not convert prime agricultural land to other uses or result in a decrease in the land's productivity.
- **Children's Environmental Health and Safety**. The USSF controls public access to VSFB and therefore no member of the public would be present around the launch site during launch operations. Therefore, the Proposed Action does not have the potential to lead to a disproportionate health or safety risk to children.
- **Natural Resources**. As defined by the FAA, the Proposed Action would not have a measurable effect on natural resources, such as water, asphalt, aggregate or wood.[1]
- **Wild and Scenic Rivers**. The Proposed Action would not affect a wild and scenic river because there are none located at or near SLC-3E.

Therefore, these impact categories are dismissed from detailed analysis because the Proposed Action would not affect them.

The Affected Environment Section 3.0 in the April 1998 *Final Environmental Impact Statement Evolved Expendable Launch Vehicle Program*, the March 2000 *Final Supplemental Environmental Impact Statement (SEIS) for the EELV Program* and the November 2003 *Final Environmental Assessment, Atlas V System from SLC-3E* establish the baseline conditions used to evaluate the environmental changes resulting from implementation of the Vulcan Centaur Program.

[1] Per FAA Order 1050.1F, the FAA is required to consider the potential impacts on "natural resources and energy supply." Energy supply is discussed under "Utilities" in this SEA. In the context of FAA's NEPA impact assessment, the FAA must consider the amount of natural resources—such as water, asphalt, aggregate, and wood—a project would use in the construction, operation, and maintenance of a project.

3.1 Biological Resources

The ROI of the Atlas V System for biological resources consists of VSFB, the adjacent Pacific Ocean, and the northern Channel Islands. Sections 3.14.2 of the 1998 FEIS and 3.14 of the 2000 FSEIS, which are incorporated by reference, describe the biological setting of VSFB, SLC-3E and the surrounding area. Sections 3.14.2.1 and 3.14.2.2 of the 1998 FEIS provide detailed descriptions of the plant communities and wildlife occurring in the ROI. Section 3.1 of the 2003 FEA discusses the specific biological setting in or near SLC-3E and immediate surroundings. Biological resources for the operational phase of the Vulcan Centaur Program from VSFB will be consistent with analysis provided in the 1998 FEIS, 2000 FSEIS and 2003 FEA and a review of these analyses shows that they are still accurate, and circumstances and conditions have not substantially changed in a manner as to require a new analysis. This SEA provides updates for relevant Biological Resource based on latest 30 SW Civil Engineering Squadron (CES)/ Civil, Environmental and Infrastructure Engineering (CEIE) guidance.

Much of the detailed Biological Resource information included was extracted from the *30 SW Integrated Natural Resources Management Plan (INRMP)*. Biological resources covered in this section include native and non-native vegetation communities, upland or wetland habitats, threatened and endangered (T&E) species and species of special concern (SSC) that occur or could potentially occur in the ROI, which is considered to be the areas surrounding SLC-3E, and could be affected by construction activities and the effects of launch operations. Sensitive and protected biological resources include plant and animal species listed as threatened or endangered by the United States Fish and Wildlife Service (USFWS) and the California Department of Fish and Wildlife (CDFW) as well as marine wildlife regulated by NOAA and National Marine Fisheries Service (NMFS). Natural areas, beyond the SLC-3E lease boundary, are managed by the USSF.

3.1.1 Regulatory Framework

3.1.1.1 Federal Regulations

Endangered Species Act (ESA). The ESA provides for the conservation of ecosystems upon which T&E species of fish, wildlife, and plants depend, both through Federal action and by encouraging the establishment of State programs. Section 7 of the ESA requires Federal agencies to ensure that any action authorized, funded or carried out by them is not likely to jeopardize the continued existence of listed species or modify their critical habitat.

Marine Mammal Protection Act (MMPA). This Act protects mammals including cetaceans (whales, dolphins, and porpoises) and other marine mammals in U.S. waters.

Migratory Bird Treaty Act (MBTA). Under this Act, taking, killing or possessing migratory birds is unlawful.

Bald and Golden Eagle Protection Act. This Act prohibits the taking or possession of, and commerce in, bald and golden eagles.

3.1.1.2 State Regulatory Requirements

California Endangered Species Act. This Act provides protection at the State level for species designated as rare, threatened or endangered.

California Coastal Act. This Act provides long-term protection of California's 1,100-mile coastline for the benefit of current and future generations. Coastal Act policies constitute standards in coastal development permit decisions and local coastal programs for review by the Coastal Commission. These policies are used by the Commission to review Federal activities that affect the coastal zone.

3.1.2 VSFB INRMP

AFMAN32-7003, *Environmental Conservation*, commits the USSF to the long-term management of all-natural areas on the installation. Long-term management objectives are identified in SLD 30's INRMP. Specific land and wildlife management objectives are identified in management plans in the appendices of the INRMP.

Section 3.1.5 provides details of the threatened, endangered and special concern species at VSFB that may include areas surrounding SLC-3E.

3.1.3 Vegetation

3.1.3.1 Native Species

Native vegetation communities on VSFB consist of approximately 14 major ecotypes. Defined vegetation types include bishop pine forest, tanbark oak forest, oak woodland, riparian woodland, wetlands, central coast maritime chaparral, coastal scrub, coastal strand, coastal salt marsh, freshwater marsh and grasslands. Other habitats include saltwater and freshwater habitats, coastal bluffs, rocky headlands and ruderal areas.

3.1.3.2 Threatened and Endangered Plant Species

Eight Federally endangered plant species are present within VSFB. ***Table 3-1: T&E Vegetation Species Found on VSFB*** contains the Federal and State of California T&E species for plants that have been documented as present on VSFB.

Table 3-1: T&E Vegetation Species Found on VSFB

Common Name	Scientific Name	Federal Classification	State of California Classification
Beach Layia	*Layia carnosa*	Endangered	Endangered
Gaviota tarplant	*Deinandra increscens*	Endangered	Endangered
Salt marsh bird's-beak	*Chloropyron maritimum*	Endangered	Endangered
Marsh sandwort	*Arenaria paludicola*	Endangered	Endangered
Gambel's watercress	*Nasturtium gambelii*	Endangered	Threatened
Lompoc yerba santa	*Eriodictyon capitatum*	Endangered	Rare
La graciosa thistle	*Cirsium scariosum*	Endangered	Threatened
Surf thistle	*Cirsium rhothophilum*	None	Threatened
Beach spectaclepod	*Dithyrea maritima*	None	Threatened
Vandenberg monkeyflower	*Diplacus vandenbergensis*	Endangered	None

3.1.3.3 Invasive Species

More than 200 non-native plant species are established on VSFB. Many of these plants pose a threat to native habitats and protected species. ***Table 3-2: 30 SW Priority Invasive Plant Species Managed*** contains a list of 30 SW priority invasive plant species requiring management.[13]

Table 3-2: 30 SW Priority Invasive Plant Species Managed

Common Name	Scientific Name
Iceplant	*Conicosia pugioniformis*
Pampas grass	*Cortaderia*
Mustard	*Brassica nigra*
Italian thistle	*Carduus pycnocephalus*
Perennial veldt grass	*Ehrharta calycina*
Harding grass	*Phalaris aquaticus*

3.1.4 Wildlife

Santa Barbara County is home to a variety of native and non-native wildlife due to its ranging ecosystems including beaches, salt marshes, freshwater marshes, pine and oak forests, coastal scrub and grasslands. Typical wildlife in the area includes the western fence lizard, garter snake, Pacific tree frogs, numerous species of fish, common birds such as seagulls, crows, mockingbirds, and various types of wading birds and herons, land mammals including the wild pig, California mule deer, coyotes, various rodents and other small mammals.

VSFB consists of diverse habitats to support migratory birds that winter and breed in western North America. The habitat on VSFB that is suitable for migrant birds is of conservation concern and is home to numerous birds listed on the USFWS migratory bird list, all of which are protected at the Federal level by the MBTA. These include the western snowy plover, California least tern and the southwestern willow flycatcher. The USSF currently has a depredation permit that covers Bird/Wildlife Aircraft Strike Hazard (BASH) issues and removal of birds/nests that if left in place could result in harm to human life.

3.1.5 Threatened and Endangered (T&E) Species

VSFB contains habitat used by many Federal and State-listed species. It is located on a mixed coastal ecosystem that is an important natural area supporting many plants and animals. Coastal habitats along the Pacific coast are important for populations of large and small mammals, migratory and resident bird species, amphibians, and reptiles. This section presents the Federal and State regulatory requirements for vegetation and wildlife and identifies the Federal and State-listed species that may be present on VSFB.

SLD 30 conducted programmatic ESA consultation with the USFWS in 2015 for routine mission operations, including launches, and maintenance activities at VSFB. The USFWS issued a Programmatic Biological Opinion (PBO), which determined that the actions covered in the consultation would not jeopardize the continued existence of any federally listed species or destroy or adversely impact any critical habitat.

3.1.5.1 Birds

The **Western Snowy Plover** (*Charadrius nivosus nivosus*) is a Federally threatened shorebird that nests and winters on the foredunes along the coast of VSFB. Nesting has been observed from Point Sal to Purisima Point and along beaches north and south of the Santa Ynez River mouth.

The **California Least Tern** (*Sternula antillarum browni)* is a Federally endangered and California State-endangered shorebird that nests from mid-April through August in several locations along the northern coastline of VSFB. Since 1998, the primary colony site for least tern nesting has been Purisima Point.

The **Southwestern Willow Flycatcher** (*Empidonax traillii extimus*) is a Federally endangered songbird that has been observed nesting at only three locations on VSFB, the most recent was in 2005. Most sightings have been within the willow riparian habitats north of the Santa Ynez River.

The **Least Bell's Vireo** *(Vireo bellii pusillus)* is a Federally endangered species that currently occurs in eight counties south of Santa Barbara. Least Bell's Vireos generally winter in southern Baja California, Mexico. Recent sightings at VSFB were in 2019 along the Santa Ynez River near Buellton and in 2020 along the Santa Ynez River and Santa Maria River.

The **Marbled Murrelet** (*Brachyramphus marmoratus)* is a Federally threatened species that is rare to observe in Santa Barbara County most of the year but may be observed during the late summer in the waters off northern VSFB. No terrestrial sightings or nesting of this species have been recorded.

The **California Condor** (*Gymnogyps californianus*) is a Federally listed species that has been observed only once on or near VSFB in 2017. Though the California condor is not currently present on VSFB, the base does have suitable foraging, roosting and potentially limited nesting habitat.

Table 3-3: VSFB Federal and State Listed Birds contains a complete list of Federal and State listed birds in VSFB.

Table 3-3: VSFB Federal and State Listed Birds

Common Name	Scientific Name	Federal	State
Common loon	*Gavia immer*	-	CSC
Ashy storm petrel	*Oceanodroma homochroa*	-	CSC
California brown pelican	*Pelecanus occidentalis californicus*	FD	SD
Least bittern	*Ixobyrchus exilis*	-	CSC
Ferruginous hawk	*Buteo regalis*	-	BCC
Northern harrier	*Circus cyaneus*	-	CSC
Golden eagle	*Aquila chrysaetos*	FP	CSC
Bald eagle	*Haliaeetus leucocephalus*	FD	SE
American peregrine falcon	*Falco peregrinus anatum*	FD	BCC
White-tailed kite	*Elanaus leucurus*	-	CP
Western snowy plover	*Charadrius nivosus*	FT	CSC
Mountain plover	*Charadrius montanus*	-	CSC/ BCC

Table 3-3: VSFB Federal and State Listed Birds

Black oystercatcher	*Haematopus bachmani*	-	BCC
Long-billed curlew	*Numenius americanus*	-	BCC
California least tern	*Sternula antillarum browni*	FE	SE
Black skimmer	*Rychops niger*	-	CSC/BCC
Marbled murrelet	*Brachyramphus marmoratus*	FE	SE
Western burrowing oil	*Athene cunicularia hypugea*	-	CSC/BCC
Long-eared owl	*Asio otus*	-	CSC
Short-eared owl	*Asio flammeus*	-	CSC
Vaux's swift	*Chaetura vauxi*	-	CSC
Costa's hummingbird	*Calypte costae*	-	CSC
Allen's hummingbird	*Selasphorus sasin*	-	CSC
Nuttall's woodpecker	*Picoides nuttallii*	-	BCC
Olive-sided flycatcher	*Contopus cooperi*	-	CSC
Little willow flycatcher	*Empidonax trailii brewsteri*	-	SE
Southwestern willow flycatcher	*Empodonax trailii extimus*	FE	SE
Loggerhead strike	*Lanius ludovicianus*	-	CSC/BCC
Purple martin	*Progne subis*	-	CSC
Oak titimouse	*Baeolophus inornatus*	-	BCC
FD – Federally Delisted	CSC – California Species of Concern		CP – California Protected
FP – Federally Protected	BCC – Federal Bird of Conservation Concern		
FT – Federally Threatened	SE – California Endangered		
FE – Federally Endangered	ST – California Threatened		SD – State Delisted

3.1.5.2 Invertebrates

The **Black Abalone** (*Haliotis cracherodii)* is a Federally endangered marine snail that rebounded in population in recent years. They occur in rocky intertidal and shallow subtidal habitats on exposed outer coasts, where they can be found in crevice microhabitats feeding on large marine algae such as kelp.

The **Vernal Pool Fairy Shrimp** *(Branchinecta lynchi*) is a Federally threatened crustacean that inhabits valley and foothill grasslands, vernal pools and wetlands. Populations have been observed and documented in vernal pools on both north and south VSFB.

3.1.5.3 Reptiles and Amphibians

The **California Red-Legged Frog** (*Rana draytonii*) is a Federally threatened and California species of concern. Present distributions range from Sonoma and Butte Counties in the north, to Riverside County in the south. California red-legged frogs require aquatic habitat for breeding but also use riparian and upland area habitats. They occur in nearly all permanent streams and ponds on VSFB as well as scattered locations along the San Antonio Creek and the Santa Ynez River.

3.1.5.4 Fish

The **Tidewater Goby** (*Eucyclogobius newberryi*) is a Federally endangered species that occurs in all major creeks on VSFB, in the Santa Ynez River and in both the Santa Ynez and San Antonio Lagoons.

The **Unarmored Threespine Stickleback** *(Gasterosteus aculeatus williamsoni)* is a Federally and State endangered, California fully protected species native to the San Antonio Creek.

The **Southern Steelhead** (*Oncorhynchus mykiss irideus*) is a Federally endangered species that occurs in the Santa Ynez River and Jalama Creek within VSFB.

3.1.5.5 Mammals

The **Southern Sea Otter** (*Enhydra lutris nereis*) is a Federally threatened species that inhabits nearshore waters and rocky coastlines of VSFB. Colonies have been observed near Purisima Point and south VSFB, including the harbor area, with transient sea otters elsewhere.

3.1.6 Marine Wildlife and Essential Fish Habitat (EFH)

Section 305(b)(2) of the Magnuson-Stevens Fishery Conservation and Management Act (MSFCMA), as amended, requires interagency coordination to further the conservation of Federally managed fisheries and each Federal agency that may adversely affect EFH to consult with the NMFS and identify EFH. The Act defines EFH as "those waters and substrate necessary to fish for spawning, breeding, feeding, or growth to maturity." Regional Fishery Management Councils under the NMFS are responsible for designating EFH in their management plans. There are 206 species managed by the Pacific Fishery Management Council that could be impacted by space vehicle launches from VSFB.

EFH for coastal migratory pelagic species includes sandy shoals and offshore bars, all coastal inlets, designated nursery habitats, and high-profile rocky bottom and barrier island ocean-side waters. This extends from the surf to 200 miles offshore along the coastline.

Areas inshore of the 100-foot contour, estuarine emergent vegetated wetlands, tidal creeks, estuarine scrub/shrub, oyster reefs and shell banks, unconsolidated bottom (soft sediments), artificial reefs, coral reefs, and live/hard bottom habitats are EFH for specific life stages of estuarine-dependent and near shore snapper-grouper species.

3.2 Air Quality

3.2.1 Air Quality (Lower Atmosphere)

This section describes air quality resources at VSFB for the atmosphere at altitudes below 3,000 feet, which contains the atmospheric boundary layer for VSFB. Atmospheric monitoring for chemicals at VSFB is within the atmospheric boundary layer where people live and work, which is defined as the ROI.

National Ambient Air Quality Standards (NAAQS) 40 CFR Part 50-51, Title V of the Clean Air Act (CAA) Part 70, Title 40 CFR Part 61 and 63 (National Emission Standards for Hazardous Air Pollutants [NESHAPs]), Title 40 CFR Part 70 (Operating Permits), California Code of Regulations (CCR), Title 17, Division 3, Chapter 1, and SBCAPCD set standards for pollutants to control levels that may affect public health and the environment.

Section 112(r) of the CAA and 40 CFR Part 68 require preparation of a Risk Management Plan (RMP) if reportable quantities of regulated and extremely hazardous chemicals are used. ULA's Atlas V Program uses no listed chemicals at or above reportable thresholds and thus is not required to prepare a RMP.

The Atlas V Program currently maintains an air permit for two natural gas fired hot water boilers, paint booth, abrasive blasting system, Rocketship and assist tug boat, ROC containing solvent use and diesel portable engines as shown in ***Table 3-4: SBCAPCD Permitted Emission Limits***. SBCAPCD rules exempt the existing hydrogen flare from obtaining an air permit. The Vulcan Centaur Program will continue to use this equipment in a similar fashion.

Table 3-4: SBCAPCD Permitted Emission Limits

Permit Number	Equipment/Process	NO_X	ROC	CO	SO_X	PM	PM_{10}	$PM_{2.5}$	Units
08930-R8	Paint Spray Booth, Building 8304	0.00	42.00	0.00	0.00	0.00	0.00	0.00	lbs/day
		0.00	5.47	0.00	0.00	0.00	0.00	0.00	TPY
09846-R8	Fuel Storage Tanks: RP-1 (2) (SLC-3E)	0.00	2.42	0.00	0.00	0.00	0.00	0.00	lbs/day
		0.00	0.02	0.00	0.00	0.00	0.00	0.00	TPY
13312-R2	Abrasive Blasting System, Building 8305	0.00	0.00	0.00	0.00	0.00	0.00	0.00	lbs/day
		0.00	0.00	0.00	0.00	0.00	0.00	0.00	TPY
13724-R1	Natural Gas Boilers (2), Building 778	9.40	0.52	7.88	1.32	0.72	0.72	0.72	lbs/day
		1.72	0.10	1.44	0.24	0.14	0.14	0.14	TPY
14736-R1	Rocketship and Assist Tug Boat (SLC-6)	3246.37	204.44	428.47	1.29	183.37	180.96	180.96	lbs/day
		10.17	0.65	1.40	0.00	0.61	0.59	0.59	TPY
15079	ROC Containing Solvent Use	0.00	31.10	0.00	0.00	0.00	0.00	0.00	lbs/day
		0.00	3.43	0.00	0.00	0.00	0.00	0.00	TPY
15080	Portable Diesel Engines (5)	183.17	24.80	254.32	0.65	9.18	9.18	9.18	lbs/day
		0.90	0.11	1.15	0.00	0.04	0.04	0.04	TPY

California established air quality standards for its State known as the California Ambient Air Quality Standard (CAAQS). In general, CAAQS are more stringent than NAAQS, and there are additional CAAQS for sulfates, hydrogen sulfide, vinyl chloride and visibility reducing particles. Ambient air monitoring records from monitoring stations maintained by the appropriate State or local agency for the affected environment are examined to characterize the existing air quality. In Santa Barbara County there is one monitoring station within close approximation to VSFB, Lompoc H Street Station that include ozone, nitrogen dioxide, carbon monoxide, sulfur dioxide and particulate matter as shown in ***Table 3-5: Measured Ambient Air Concentrations of Criteria Pollutants in Lompoc***.

Table 3-5: Measured Ambient Air Concentrations of Criteria Pollutants in Lompoc

Pollutant	Average Time	Nearest Monitoring Station	Maximum Measured Concentration (ppm, except PM in µg/m³)		
			2016	2017	2018
O3	1 Hour	Lompoc H Street	68	63	44
O3	8 Hour	Lompoc H Street	61	56	42
NO_2	1 Hour	Lompoc H Street	34	33	28
SO_2	1 Hour	Lompoc H Street	5	2	3

Pollutant	Average Time	Nearest Monitoring Station	Maximum Measured Concentration (ppm, except PM in µg/m³)		
			2016	2017	2018
CO	1 Hour	Lompoc H Street	1.3	1.5	1.1
$PM_{2.5}$	24 Hour High	Lompoc H Street	30	53.4	41
PM_{10}	24 Hour High	Lompoc H Street	48	114	63
Source: https://www.ourair.org/sbc/annual-air-quality-report/					

ULA, as required by SBCAPCD regulations, will submit an Air Quality Impact Analysis with its application for an Authority to Construct. The Air Quality Impact Analysis will be conducted pursuant to Rule 805, Air Quality Impact Analysis, Modeling, Monitoring, and Air Quality Increment Consumption, and will demonstrate to the satisfaction of the Control Officer that the Vulcan Centaur vehicle launch emissions will not cause a violation or interfere with the expeditious attainment or maintenance of any ambient air quality standard or prevent reasonable progress towards the expeditious attainment or maintenance of any ambient air quality standard or cause any ambient air quality increment to be exceeded.

Use of Class I ozone depleting chemicals (ODC) is prohibited at VSFB. The Atlas V program does not use any Class II ODCs. As referenced in the 2000 EELV Program SEIS, the SRMs would create a temporary local ozone loss which will occur at each launch using SRMs.

Vehicles will emit exhaust CO, NO_x, PM and SO_2 during project construction and launch operation activities. Dust particles (PM) are generated during construction activities. Equipment used to grade, dig, and perform other construction related activities emit exhaust and dust particulates. The two main pollutants of concern in diesel exhaust that affect human health are NO_x and PM; however, the California Air Resource Board regulates emissions for additional HAPs in diesel fuel.

A New Source Review (NSR) will be required for any source with the potential of emitting pollutants regulated under the CAA in amounts exceeding standard thresholds. All stationary sources are reviewed by SBCAPCD permitting process and are subject to NSR process.

SBCAPCD regulations require that facilities building, altering, or replacing stationary equipment that emits air pollutants obtain an Authority to Construct permit prior to erecting the source. SBCAPCD regulations also require a stationary source of air pollutants to obtain a Permit to Operate once the source is operational. Local air districts perform review of applications and approval and issuance of these permits. If a stationary source emits 25 tons per year or more of any pollutant, excluding CO, in a 12-month period during construction, emission beyond significance thresholds must be offset by applying emission reduction credits.

3.2.2 Climate

Regional climate and meteorology for VSFB described in the 1998 FEIS Section 3.10.3, 2000 FSEIS Section 3.10.3 and 2003 FEA Section 3.2.1, incorporated by reference, are still accurate, and circumstances and conditions have not changed in a manner as to require a new analysis. The typical weather at VSFB can be summarized as cool and wet from November through April

with average high temperatures ranging from 63 to 68 degrees and lows ranging from 42 to 47 degrees. From May through October warm and dry conditions are present with high temperatures ranging from 68 to 74 degrees and lows ranging from 50 to 56 degrees. Average precipitation for the year is 16.11 inches. The predominant average hourly wind direction in VSFB varies throughout the year. The wind direction is most often from the west from mid-May through early September. The wind is most often from the north the remainder of the time year. Average wind speeds range from 8.8 to 11.5 miles per hour.

3.3 Historical and Cultural Resources

Cultural resources include prehistoric-archaeological, historic, architectural, Native American resources, and any physical evidence of human presence considered important to a culture, subculture, or community for scientific, traditional, religious or any other reasons. Historic properties refer to prehistoric, historic, or traditional, significant cultural resources. Areas potentially impacted include properties, structures, landscapes, or traditional cultural sites that qualify for listing in the National Register of Historic Places (NRHP).

Cultural resources for SLC-3E VSFB described in the 1998 FEIS Section 3.15, 2000 FSEIS Section 3.16 and 2003 FEA Section 3.3, incorporated by reference, are still accurate, and circumstances and conditions have not changed in a manner as to require a new analysis.

3.3.1 Regulatory Framework

Section 106 of the National Historic Preservation Act (NHPA) of 1966 (as amended) requires Federal agencies to consider the effects of their actions on historic properties. Historic properties are defined as "prehistoric or historic district, site, building, structure, or object included in, or eligible for inclusion on, the National Register of Historic Places, including artifacts, records, and material remains related to such a property or resource". AFMAN 32-7003, *Environmental Conservation*, 20 April 2020, provides guidelines for protecting and managing cultural resources on USSF-managed lands.

Federal cultural resource preservation statutes (including the Native American Graves Protection and Repatriation Act (NAGPRA) (1990) mandate that if prehistoric or historic artifacts are unexpectedly discovered during construction or excavation, such materials would be identified and evaluated by an archaeologist. Should human remains or cultural artifacts be encountered, Federal statutes specify that work would cease immediately, and the proper authorities be notified. SLD 30 Cultural Resource Manager and archaeologist work with the State Historic Preservation Office (SHPO) and the Santa Ynez Band of Chumash Indians should unexpected discoveries occur. Project delays may take place to ensure mitigation measures are met and protection of the cultural resources is achieved. Re-commencement would only be authorized once SLD 30 Cultural Resource Manager and/or the archaeologist clears the site.

In addition to the NEPA, the primary laws that pertain to the treatment of cultural resources during environmental analysis are the NHPA (especially Sections 106 and 110), the Archaeological Resources Protection Act (ARPA) (1979), the American Indian Religious Freedom Act (AIRFA) (1978), and the NAGPRA.

Only those cultural resources determined to be potentially significant under the above-cited legislation are subject to protection from adverse impacts resulting from an "undertaking." To

be considered significant, a cultural resource must meet one (1) or more of the criteria established by the National Park Service that would make that resource eligible for inclusion in the NRHP. The term "eligible for inclusion in the National Register" includes all properties that meet the National Register listing criteria, which are specified in the Department of the Interior Regulations Title 36 CFR Part 60.4 and National Register Bulletin 15. Sites not yet evaluated, and at least 50 years old, may be considered potentially eligible for inclusion in the National Register and are afforded the same regulatory consideration as nominated properties.

3.3.2 Prehistoric and Historic Archaeological Resources

The prehistory of California's central coast spans the entire Holocene and may extend back to late Pleistocene times. Excavations on VSFB reveal occupations dating to the Pleistocene/Holocene transition, around 11,000 years ago (Lebow et al. 2014; Lebow et al. 2015). Occupations during earliest part of the Holocene (9,000 to 10,000 years) have been identified at several sites on VSFB (Glassow 1990, 1996; Lebow et al. 2001, 2006, 2007; Stevens 2011). 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 remained 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 VSFB, 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 VSFB area prior to historic contact are grouped with the Purisimeño 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 1984:118). 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 1978:520). About five ethnohistoric villages are identified by King (1984: Figure 1) on VSFB, along with another five villages in the general vicinity. Diseases introduced by early Euro-American explorers, beginning with the maritime voyages of Cabrillo in Anno Domini (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.

VSFB 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 Purisima 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. The Suburban Period (1945–1965) began with the end of World War II. In 1956, the army transferred 64,000 acres of North Camp Cooke to the Air Force, and it was renamed the Cooke Air Force Base. In 1958 the base had its first missile launch, the Thor, and was renamed Vandenberg AFB (Palmer 1999).

3.4 Water Resources

Water Resources for VSFB described in the 1998 FEIS Section 3.9, 2000 FSEIS Section 3.9 and 2003 FEA Section 3.4, incorporated by reference, are still accurate, and circumstances and conditions have not changed in a manner as to require a new analysis.

3.4.1 Groundwater

Groundwater for VSFB described in the 1998 FEIS Section 3.9.2.1, 2000 FSEIS Section 3.9 and 2003 FEA Section 3.4.1, incorporated by reference, are still accurate, and circumstances and conditions have not changed in a manner as to require a new analysis.

3.4.2 Surface Water

Surface Water for VSFB described in the 1998 FEIS Section 3.9.2.2, 2000 FSEIS Section 3.9 and 2003 FEA Section 3.4.2, incorporated by reference, are still accurate, and circumstances and conditions have not changed in a manner as to require a new analysis. No dredging is proposed directly as part of Proposed Action. ULA will adhere to the existing Regional General Permit as well as Federal, State and local requirements for all dredging activities.

3.4.3 Water Quality

Water Quality for VSFB described in the 1998 FEIS Section 3.9.2.3, 2000 FSEIS Section 3.9 and 2003 FEA Section 3.4.3, incorporated by reference, are still accurate, and circumstances and conditions have not changed in a manner as to require a new analysis.

The Proposed Action would require coverage under the NPDES General Permit for Construction Activities (Construction General Permit) because the total disturbed area would be greater than 1 acre.

3.5 Hazardous Materials and Solid and Hazardous Waste

This section addresses the existence or use of hazardous materials or the existence or production of solid or hazardous waste at the Proposed Action locations. The section also includes the proper management of hazardous materials and proper disposal of wastes. Hazardous materials and hazardous waste management for the Vulcan Centaur Program will remain consistent with VSFB described in the 1998 FEIS Section 3.6.3, 2000 FSEIS Section 3.6.2 and 2003 FEA

Section 3.5, incorporated by reference, are still accurate, and circumstances and conditions have not changed in a manner as to require a new analysis.

3.5.1 Hazardous Materials Management

Hazardous materials include all chemicals identified and regulated under the Emergency Planning and Community Right-to-Know Act (EPCRA), Occupational Safety and Health Administration (OSHA) Hazardous Communication (HAZCOM) Standard, Hazardous Materials Transportation Act (HMTA), Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA), Toxic Substance Control Act (TSCA), CCR Title 22 and the CAA. ULA currently purchases and manages all hazardous materials proposed for the Vulcan Centaur Program through the Atlas V program except for LNG, which is proposed for use in the first stage Vulcan Centaur BE-4 engine. ULA uses its internal supply system to purchase hazardous materials. LO_2, LN_2 and LH_2 purchases are managed through the Atlas purchasing organization.

ULA's Hazardous Material Response Team has the primary responsibility for responding to; deploying containment, stabilization and cleanup of any release of hazardous materials at SLC-3E. In the event of a hazardous material release, ULA will notify 30 SW CES-VSFB Fire Department concerning nature of release and response measures performed by ULA. Response to an emergency will be conducted in accordance with AFMAN 32-7002, *Environmental Compliance and Pollution Prevention*. ULA is responsible for the coordination of all environmental emergency response actions on its leased premises.

ULA maintains its own site-specific Integrated Contingency Plan (ICP). This plan will be expanded to cover Vulcan Centaur operations. This plan covers response to non-emergency spills and leaks and clean-up of all spill or leak incidents. ULA would also be responsible for completing all State and EPA notifications if the spill/release exceeds reporting thresholds.

3.5.2 Solid Waste Management

Solid waste from the Proposed Action and future operations will be managed by a contract with a commercial waste management company. Proper management and disposal of solid waste from construction will be the responsibility of the construction contractor. Construction and demolition debris (C&D) waste generated during Vulcan Centaur Program modifications at SLC-3E are anticipated to be substantially less than the C&D waste generated in support of Atlas V SLC modifications, which required substantial modifications to the launch exhaust duct and MST. During operation activities, solid waste would be expected to be similar to the Atlas V program.

3.5.3 Hazardous Waste Management

Hazardous waste is defined in Resource Conservation and Recovery Act (RCRA) as any solid, liquid, contained gaseous or semi-solid waste, or any combination of wastes that could or do pose a substantial hazard to human health or the environment. Waste may be classified as hazardous because of its toxicity, reactivity, ignitability or corrosivity. In addition, certain types of waste are "listed" or identified as hazardous in 40 CFR Part 261. In regulatory terms, a RCRA hazardous waste is a waste that appears on one of the four hazardous waste lists (F-list,

K-list, P-list, or U-list) or exhibits at least one of four characteristics: ignitability, corrosivity, reactivity, or toxicity.

Hazardous waste management at VSFB is regulated under RCRA (40 CFR Part 260-280), CCR Title 22 and SLD 30 Plan 32-7043A Hazardous Materials Management Plan. ULA has an EPA hazardous waste generator ID number from the EPA for the current Atlas V and Delta IV operations and is responsible for managing and disposing of all hazardous waste generated. ULA currently manages all Atlas V Program hazardous waste generated from its operations in accordance with all local, State, and Federal regulations and its Hazardous Waste Management Plan. The Atlas V Program maintains a 180-day hazardous waste storage site located at SLC-3E. All individuals or organizations generating hazardous waste at VSFB are responsible for administering all applicable regulations and plans regarding hazardous waste.

3.5.4 Pollution Prevention

Pollution prevention is reducing or eliminating waste at the source by promoting the use of non-toxic or less toxic substances, modifying production processes, reusing materials to reduce waste and implementing conservation techniques. The Federal Compliance with Pollution Control Standard (EO 12088) and the USAF Civil Engineer Environmental Management (AFI 32-7001) give guidance on measures for pollution. ULA's policy is to reduce hazardous material use and minimize waste generation. ULA launch programs consider pollution prevention in the design of both the launch system and vehicle. Environmental aspects of design decisions are considered during all design phases.

3.5.5 Installation Restoration Program (IRP)

The IRP is a USSF program that identifies, characterizes, and remediates past environmental contamination on USAF and USSF installations. The program has established a process to evaluate past disposal sites, control the migration of contaminants, and control potential hazards to human health and the environment. IRP for SLC-3E described in the 2003 FEA Section 3.5.3, incorporated by reference, is still accurate, and circumstances and conditions have not changed in a manner to require a new analysis.

Construction activities associated with the Proposed Action are within IRP Site Cluster WP005 boundaries. WP005 includes Site 5, Site 6 and Site 7.

IRP Site 5 consists of Space Launch Complex 3 East (SLC-3E), which includes a control center, support center and one launch pad as well as an associated lined retention basin and deluge water channel and nearby grounds. The facilities at SLC-3E are currently occupied by ULA.

IRP Site 6 includes Space Launch Complex 3 West (SLC-3W). The SLC-3W launch facility was decommissioned on January 22, 2000. Currently this site is going under remediation by IRP contractor.

IRP Site 7 includes Bear Creek, a section of Bear Creek Canyon, Bear Creek Pond. Currently this site is going under remediation by IRP contractor.

Potential sources of contamination at WP005 may be attributed to historical SLC-3E and SLC-3W pre-launch degreasing operations, propellants and launches, post-launch sandblasting and painting operations, retention basin discharge and leaks from underground storage tanks. The

primary constituents of concern (COCs) previously identified in groundwater at WP005 include trichloroethene (TCE) and other chlorinated breakdown products, which have been detected at concentrations that exceed their respective maximum contaminant level (MCL).

Decision document was finalized in September 2017 to remediate the IRP Site in accordance with the Comprehensive Environmental Response, Compensation, and Liability Act of 1980 (CERCLA), as amended by the Super fund Amendments and Reauthorization Act of 1986 (SARA), and to the extent practicable, the National Contingency Plan (NCP). As presented, this decision document is termed a Record of Decision (ROD).[14]

3.6 Health and Safety

Range safety organizations review, approve, monitor, and impose safety holds, when necessary, on all pre-launch and launch operations per UNITED STATES SPACE FORCE COMMAND MANUAL 91-710 (USSF) . The objective of the range safety program is to ensure that the general public, launch area personnel, foreign land masses, and launch area resources are provided an acceptable level of safety and that all aspects of pre-launch and launch operations adhere to public laws.

The risk management framework established for the Atlas V System, as described and incorporated by reference, in the 1998 FEIS Section 3.7.3, 2000 FSEIS Section 3.7.2 and 2003 FEA Section 3.6 will be substantially similar to the Vulcan Centaur Program for health and safety issues.

3.6.1 Operations Safety

ULA complies with OSHA Standards 29 CFR Part 1910, *Occupational, Safety, and Health Standards* requirements for the protection of health and safety and 29 CFR Part 1926, *Safety and Health Regulations for Construction* during project construction. ULA maintains fire protection systems that comply with NFPA requirements as applied by the VSFB Authority Having Jurisdiction, Unified Facilities Criteria and DoD Engineering Technical Letter (ETL) guidance and direction. Fire protection alarms are monitored by the VSFB Fire Department. Hazardous materials such as propellants, ordnance, chemicals and other payload components must be transported to VSFB in accordance with DOT regulations for interstate shipment of hazardous substances (Title 49 CFR Parts 100-199). Hazardous materials such as LH_2, LO_2, LN_2 and LNG must be transported in specially designed containers to reduce the potential of a mishap should an accident occur. For some hazardous materials, each State may have its own required transportation routes, time of shipments, and permits. To date, no major accidents involving the shipment of hazardous materials associated with launch vehicles at VSFB have occurred.

3.6.2 VSFB Safety Requirements

Launches are not allowed to proceed if an undue hazard exists for persons and property due to potential dispersion of hazardous materials or propagation of blast overpressure. SLD 30 has prepared detailed procedures to be used to control toxic gas hazards. Atmospheric dispersion computer models are run to predict toxic hazard corridors (THCs) for both nominal and aborted launches, as well as spills or releases of toxic materials from storage tanks or that occur during

loading or unloading of tanks. Range Safety uses the THCs to reduce the risk of exposure of VSFB personnel and the general public to toxic materials, including toxic gases.

Emergency response to major aerospace vehicle and hazardous material incidents is provided by the VSFB Emergency Response Team as directed in the Air Force Emergency Management Program, AFI 10-2501.

3.6.2.1 Range Safety Procedures

USSF COMMAND MANUAL 91-710 Range Safety Requirements directs overall safety regulations for CCAFS and VSFB. It outlines the process for reviews, approves and operation safety including monitors, safety holds on all launch operations.

Impact debris corridors would be established for the Vulcan Centaur vehicle on a mission (launch) basis as part of the program's safety review using the results of a debris analysis. Impact debris corridors would be established off the Santa Barbara County, California coast over the Pacific Ocean to meet security requirements and reduce the hazard to persons and property during a launch-related activity. Impact debris corridors are established through the designation of debris impact areas for each specific launch within the Preliminary Flight Data Package (PFDP) document.

The 1998 FEIS Section 3.7.3.1 provides regional safety and notification criteria for the Atlas V Program that will remain substantially consistent for the new Vulcan Centaur Program.

Mission reliability is measured from launch commit and is defined as the probability of successfully placing the payload into its delivery orbit with the required accuracy, and then executing a collision avoidance maneuver. Adherence to specific standards for mission/vehicle reliability are contained in USSF COMMAND MANUAL 91- 710, Range Safety Requirements is required.

3.6.2.2 30 SW and FAA Air Traffic Directives

Control of air traffic in FAA-designated areas around the launch head is maintained and coordinated between the Military Radar Unit and FAA to ensure that non-participating aircraft are not endangered by launches. The Military Radar Unit restricts aircraft movement in Restricted Airspace and Warning Areas beginning 15 minutes prior to the scheduled launch time and until the launch is complete.

Zone closures are announced daily over various radio frequencies and posted in harbors along the coast. SLD 30 Flight Analysis notifies the 2nd Range Operations Squadron of areas that are hazardous to shipping for all normally jettisoned and impacting stages by 30 working days prior to launch. This information is published weekly in the US Coast Guard Broadcast to Mariners. Broadcasts by US Coast Guard provide the latest available hazard information to offshore surface vessels. VSFB would assume control of and could set-up a national defense area if protected material were involved in any launch vehicle accident. In the event of a launch vehicle impacting areas outside VSFB, the on-scene emergency response team from VSFB would respond to the accident upon request of the County. County agencies would be requested to help in the evacuation and possible fire control for such an incident. Military personnel would assume responsibility for disaster control in the immediate impact area.

3.6.2.3 Quantity Distance Criteria Requirements

Explosive safety quantity-distance criteria are used to establish safe distances from LCs and associated support facilities to non-related facilities and roadways. DoD, Space Force and Air Force Explosive Safety Standards establish these regulations. The criteria use the trinitrotoluene (TNT) explosive equivalent of propellant to determine safe distances from space launch operations or processing and holding areas. As specified in USSF COMMAND MANUAL 91-710, all facilities would be properly sited and approved in accordance with DoD quantity distance criteria and AFMAN 91-201 Explosives Safety Standards.

A memorandum, dated November 2019 pertaining to the Vulcan Centaur Program Modifications was provided by SLD 30/SEAL Chief Launch Vehicle System Engineer, specifically regarding the "impacts of storing and using larger amounts of liquid hydrogen and liquid oxygen than are currently being use, and the addition of liquid natural gas storage for first stage Vulcan booster." The subject memorandum, included as ***Appendix C***, acknowledged the new LNG system and modifications to the existing LO_2 and LH_2 systems; identified the procedure, protocols and regulations for siting approval; and concluded the following:

> "It is 30 SW/SEAL opinion that the increase liquid hydrogen and oxygen, with the new storage of LNG, is in compliance with range and industry requirements for these commodities. Further, USSF COMMAND MANUAL 91-710 is the culmination of lessons learned derived from processing hazardous commodities for space lift and missile systems at the ranges and is being used to guide SLC-3E flight and ground system upgrades. Also, ULA has extensive knowledge processing these or similar commodities on the range with an impeccable safety record. It is the opinion of 30 SW/SEAL that modifications required to support the Vulcan Centaur Program at SLC-3E pose no increase risk to the human environment than the current processes. These site and vehicle modifications should be considered baselined to the existing Atlas V operations."

3.6.2.4 Security Requirements

Access to VSFB is secured by manned guard stations and fencing. All employees and visitors must have access badges to gain entrance to VSFB. VSFB is responsible for ensuring USSF security requirements are maintained, including addressing terrorist threats. SLC-3E adheres to ULA's site security requirements, including ULA access badging, LC fencing, security lighting, and intrusion detection cameras.

Further Antiterrorism procedures would be established by ULA as required, in concert with USSF guidance, to improve the safe transport of any vehicle, payload or other item entering VSFB.

3.7 Land Use

Land use is defined as the human usage of land resources for uses such as economic production, natural resources protection, residential or commercial uses. Compatible land use is achieved when the Proposed Action fits within the land use patterns (such as vehicle launches, residential, commercial, industrial, recreational), land ownership (federal, State, private), and land use management plans. Zoning, management plans and policies regulate how land is used. Land

uses described are regional land use and zoning, on-station/base land use and zoning and coastal zone management (CZM). Visual resources are any naturally occurring or manmade feature that contributes to the aesthetic value of an area. The term coastal zone is defined as the coastal waters (including the lands therein and thereunder) and the adjacent shorelands (including the waters therein and thereunder) strongly influenced by each other and in proximity to the shorelines of the several coastal States, and includes islands, transitional and intertidal areas, salt marshes, wetlands, and beaches (16 U.S.C. 1453).

Land Use and Aesthetics for the operational phase of the Atlas V System from Vandenberg SFB were described in the FEIS, Section 3.3.2, which is incorporated by reference. A review of these analyses showed that they are still accurate, and circumstances and conditions have not changed in a manner as to require a new analysis.

Santa Barbara County, the City of Lompoc and the City of Santa Maria are the local planning authorities for incorporated and unincorporated areas near VSFB and designate compatible land uses and zoning around VSFB. VSFB designates its own land use and zoning regulations since it is Federal-owned and is not included under the land use or zoning authority.

South VSFB is under supervision of the 30 Space Wing Instruction (SWI) 32-102, Fire Prevention division of the Santa Barbara County Fire Department.

Uses of the ocean waters and coastline adjacent to SLC-3E are protected as State of California designated Vandenberg State Marine Reserve (Purisma Point south to VSFB's Boathouse) as outlined the 30th Space Wing Instruction 32-7001, section 15.4.2.1.

3.7.1 Coastal Zone Management

The Coastal Zone Management Act (CZMA), enacted in 1972, encourages States to preserve, protect, develop, and, where possible, restore or enhance valuable natural coastal resources such as wetlands, floodplains, estuaries, beaches, dunes, barrier islands, and coral reefs, as well as the fish and wildlife using those habitats. Federal activity in, or affecting, a coastal zone requires preparation of a Coastal Zone Consistency Determination or Negative Determination, in accordance with the Federal CZMA of 1972, as amended (P.L. 92-583), and implemented by the National Oceanic and Atmospheric Administration (NOAA). CZM Program administration has been delegated to States that develop State specific guidelines and requirements. The Office of Ocean and Coastal Resource Management administers individual State programs. Federal property is exempt from the definition of States coastal zones, but activities occurring on Federal property that directly affect State coastal zones must comply with the CZMA. Section 307(c)(1)(A), Coordination and Cooperation, mandates that each Federal agency activity within or outside the coastal zone that affects any land or water use or natural resource of the coastal zone would be carried out in a manner which is consistent, to the maximum extent practicable, with the enforceable policies of approved State management programs.

Applicable Federal actions must be consistent with NOAA's Federal consistency regulations at 15 CFR Part 930. Federal consistency is required for Federal actions that are defined as Federal activities, including any development projects (15 CFR Part 930, Subpart C).

VSFB has 33 miles of coastline, consisting of a variety of natural communities that include coastal dunes and coastal dune scrubland, coastal salt marshes, coastal bluffs, and rocky coastlines and beaches. Disturbances to some of these areas have been due to past cattle grazing,

off-road vehicle (ORV) use, and past military-related development. Several of these natural communities contain endangered and other special-status plant species or are used as habitat or roosting sites for threatened, endangered, and other special-status animal species.

Management of these areas is important to maintain their health and that of the species in them. Coastal issues affecting VSFB include requirements of coastal consistency and negative determinations, protection of marine animals, special management areas for threatened and endangered species, public and military recreation access, the Vandenberg State Marine Reserve, and the Marine Ecological Reserve. The Coastal and Riparian Habitats Management Plan contains additional information regarding these resources.

On VSFB, the coastal zone extends inland from approximately 0.75 mile at the northern boundary to 4.5 miles at the southern end of the base. The Proposed Action is within the coastal zone. The USSF is responsible for making the final coastal zone consistency determinations for its activities within the State, and the California Coastal Commission (CCC), South Central Coast District, will review the CZMA plan to ensure the proposed action is consistent with the coastal zone consistency determination through submittal of this SEA.

3.7.2 Light Emissions

The ROI for light emission effects includes people, wildlife and land uses in the SLC-3E area. Light emissions from the proposed Vulcan Centaur Program are expected to be nearly identical to the emissions from the current Atlas V Program. Light emissions from the SLC-3E are not visible from existing populated areas outside VSFB except during nighttime launch events, where additional mobile search lights are used to illuminate the launch pad.

3.8 Noise

Noise is usually defined as unwanted sound. The decibel (dB) is the accepted standard unit for the measurement of sound and is a logarithmic unit that accounts for the large variation in sound pressure amplitudes. Environmental noise is often expressed in terms of A-weighted (dBA) noise levels. A-weighting simulates the frequency response of the human hearing mechanism. The Environmental Protection Agency (EPA) administers the Noise Control Act of 1972 and has identified 65 dB Day Night Average Noise Level (DNL) as an acceptable noise level for compatible land uses. The DNL is essentially a 24-hour average of noise levels with 10 dB added to nighttime noise levels (10 pm to 7 am). The 10 dB correction accounts for increased sensitivity to nighttime noise. ***Table 3-6: A-weighted Sound Levels of Common Sounds*** contains common sound examples.

Table 3-6: A-weighted Sound Levels of Common Sounds

Common Sounds	Sound Level Range (dB)	Region of Comfort
Threshold of Hearing	0-10	Just Audible
Recording Studio	10-20	
Bedroom at Night	20-30	
Quiet Urban Nighttime	30-40	Quiet
Average Office	40-50	
Air Conditioner at 100 ft (30.5m)	50-60	
Conversational speech	60-70	Moderate

Common Sounds	Sound Level Range (dB)	Region of Comfort
Normal Piano Practice		
Heavy Truck at 50 ft (15.2m)	70-80	
Riding Mower	80-90	
Light-duty Bulldozer	90-100	Very Loud
Textile Mill or Discotheque	100-110	
Oxygen Torch	110-120	Uncomfortable
Chain Saw	120-130	
Jet Aircraft at takeoff	140	
Primary Source[15]		

Descriptors are used to assess and correlate the various effects of noise on humans, including land use compatibility, sleep and speech interference, annoyance, hearing loss, and startle effects. Although derived for humans, these descriptors can also be used to qualitatively assess the effects of noise on wildlife. These descriptors are shown in ***Table 3-7: Sound Level Descriptors***.

Table 3-7: Sound Level Descriptors

Descriptor	Description
A-Weighted Sound Level	The momentary magnitude of sound weighted to approximate the human ear's frequency sensitivity. A-weighted sound levels are typically measured between 20 hertz and 20 kilohertz.
Level Equivalent A-Weighted Sound Level (LAeq)	An A-weighted sound level that is "equivalent" to an actual time-varying sound level
Day-Night Average Noise Level (DNL)	An A-weighted equivalent sound level averaged over a 24-hour period with a 10-dB "penalty" added to nighttime sounds (10:00 p.m. to 7:00 a.m.). The DNL has been adopted by federal agencies as the standard for measuring environmental noise.
C-Weighted Sound Level	Measures sound levels in dB, with no adjustment to the noise level over most of the audible frequency range except for a slight de-emphasis of the signal below 100 hertz and above 3,000 hertz. It is used as a descriptor of low-frequency noise sources, such as blast noise and sonic booms.
C-Weighted Day-Night Level (CDNL)	The C-weighted sound level averaged over a 24-hour period; with a 10-dB penalty added for noise occurring between 10:00 p.m. and 7:00 a.m. CDNL is similar to DNL, except that C-weighting is used rather than A-weighting.
Sound Exposure Level (SEL)	A-weighted SEL. The total sound energy in a sound event if that event could be compressed into one second. SEL converts the total sound energy in a given noise event with a given duration into a 1-second equivalent, and, therefore, allows direct comparison between sounds with varying magnitudes and durations.
C-Weighted Sound Exposure Level (CSEL)	C-weighted SEL. The same as SEL except the measurement is in C-weighting rather than A-weighting.
Peak Overpressure	A measure of changes in air pressure and is often measured in units of pounds per square foot (psf). Peak overpressure is often used to measure the magnitude of sonic booms, particularly with respect to evaluating the potential for structural damage.

The ROI for noise includes the area around SLC-3E, VSFB, and the closest populated areas, which are Lompoc about 8 miles to the southeast and the cities of Orcutt and Santa Maria which lie to the northeast of the base about 10 and 15 miles, respectfully. Three noise areas associated with the Proposed Action are evaluated, Construction Noise, Launch Operations Noise and Launch and Ascent Noise.

Noise levels around industrial facilities at VSFB approximate those of any urban industrial area, reaching levels of 60 to 80 dBA. Other less frequent but more intense sources of noise in the region are launches from VSFB. The distance from these communities reduces the effect of potential noise generated from the Proposed Action. Residential and commercial areas along the beach would be expected to have low overall noise levels, normally about 45 to 55 dBA. Infrequent aircraft fly-overs and rocket launches from VSFB would be expected to increase noise levels for short periods of time.

The largest portion of the total acoustic energy produced by a launch vehicle is usually contained in the low-frequency end of the spectrum (1 to 100 Hertz). Launch vehicles also generate sonic booms. A sonic boom, the shock wave resulting from the displacement of air in supersonic flight, differs from other sounds in that it is impulsive and very brief.

3.8.1 Launch Operations Noise

Operation-related noise refers to noise generated from activities such as actual launches and also temporary noise during construction, maintenance or refurbishment activities and ongoing noise generated from worker traffic to and from the selected site. Launch is the major source of all operational noise. Three distinct noise events are associated with launch and ascent of a launch vehicle: on-pad engine noise, in-flight engine noise, and sonic booms. Operations-related noise from the actual launches are summarized below.

3.8.1.1 On-pad Noise

On-pad engine noise occurs when engines are firing, but the vehicle is still on the pad. The engine exhaust is deflected horizontally by an exhaust tunnel or flame duct. Noise is highly directional, with maximum levels in lobes that are about 45 degrees from the main direction of the deflected exhaust. Noise levels at the vehicle and within the LC are high. Because the sound source is at or near ground level, propagation from the launch vehicle to off-site locations is along the ground, with significant attenuation over distance. On-pad noise levels are typically much lower than in-flight noise levels because sound propagates in close proximity to the ground and undergoes significant attenuation when the vehicle is on or near the pad.

3.8.1.2 In-flight Noise

In-flight noise occurs when the vehicle is in the air, clear of the launch pad, and the engine exhaust plume is in line with the vehicle. In the early part of the flight, when the vehicle's motion is primarily vertical, noise contours are circular, particularly for the higher levels near the center. The outer contours tend to be somewhat distorted. They can be stretched out in the launch direction or broadened across the launch direction, depending on specific details of the launch. Because the contours are approximately circular, it is often adequate to summarize noise by giving the sound levels at a few distances from the launch site. The in-flight sound source is also well above the ground and therefore there is less attenuation of the sound as it propagates to large distances.

The major source of in-flight noise is from mixing of the exhaust flow with the atmosphere, combustion noise in the combustion chamber, shock waves and turbulence in the exhaust flow, and occasional combustion noise from the post-burning of fuel-rich combustion products in the atmosphere. The emitted acoustic power from a rocket engine and the frequency spectrum of the

noise can be calculated from the number of engines, their size and thrust, and their flow characteristics. Normally, the largest portion of the total acoustic energy is contained in the low-frequency end of the spectrum (1 to 100 hertz).

3.8.1.3 Sonic Booms

Sonic booms occur when vehicles reach supersonic speeds. A sonic boom is the shock wave resulting from the displacement of air in supersonic flight. It differs from other sounds in that it is impulsive and very brief. In many cases an ascending launch vehicle's orientation at the Mach 1 (speed of sound) is nearly vertical and therefore the sonic boom ray cone would not impinge on the earth's surface and would not be heard. Conversely, a descending launch vehicle's orientation often would cause a sonic boom to impinge on the earth's surface and be heard.

3.8.2 Construction Noise

Temporary noise impacts from the operation of construction equipment (e.g., earth moving machinery, dump trucks, power tools) are usually limited to a distance of 1,000 feet or less. Vehicles associated with construction typically generate between 65 and 100 dBA at a distance of 50 feet.[16] In addition, noise diminishes at a rate about 6 dBA for each doubling of distance from the source. VSFB has no sensitive receptors (e.g., schools, hospitals) in its vicinity. All construction work would be conducted as normal activities on VSFB primarily during daytime (7:00 AM through 10:00 PM) hours; however, critical construction activities may be scheduled during nighttime (10:00 PM through 7:00 AM) to support the Vulcan Centaur Program and not impact current facility operations. The area immediately surrounding VSFB is mainly undeveloped and rural. Sound levels measured for most of the region are normally low, with higher levels appearing in industrial areas and along transportation corridors. Rural areas in the Lompoc and Santa Maria valleys would be expected to have low overall CNEL levels, normally about 40 to 45 dBA. Infrequent aircraft flyovers and rocket launches from VSFB would be expected to increase noise levels for short periods of time. (City of Lompoc, 1996).

3.9 Environmental Justice

Environmental justice is defined by the EPA as "The fair treatment and meaningful involvement of all people regardless of race, color, national origin or income with respect to the development, implementation, and enforcement of environmental laws, regulations, and policies."

Title 32 CFR Part 989.33, Environmental Justice, and AFI 32-7061, Environmental Impact Analysis Process, require that a project proponent comply with EO 12898, *Federal Actions to Address Environmental Justice in Minority Populations and Low-Income Populations*. The EO requires Federal agencies to identify and address, as appropriate, disproportionately high and adverse human health or environmental effects of their programs, policies, and activities on minority and low-income populations and to ensure that these types of impacts are considered in EAs and other environmental documents. DOT Order 5610.2(a), *Final DOT Environmental Justice Order*, requires FAA to analyze impacts on low-income and minority populations.

The 2010 Census of Population and Housing reports numbers of minority residents. Minority populations included in the census are identified as Black or African American, American Indian and Alaskan Native, Asian, Native Hawaiian/Other Pacific Islander, Hispanic or Other. Based upon the 2010 Census of Population and Housing, Santa Barbara County had a population of

543,376 persons. Of this total, 122,022 persons, or 22.5 %, were minority. Orange County had a population of 1,145,956 persons, of this total, 686,080 persons or 59.9% were minority. The largest segment of the minority population is Hispanic at 26.9%.[17]

3.10 Orbital and De-Orbiting Debris

This section addresses the potential hazards and environmental impacts associated with manmade orbital and de-orbiting debris. Orbital and de-orbiting debris is a concern as a potential collision hazard to spacecraft including ULA Vulcan Centaur vehicle. Large pieces of debris are of concern with respect to re-entry and eventual Earth impact. Space debris can be classified as either natural or manmade objects. The measured amount of manmade debris equals or exceeds that of natural meteoroids at most low earth orbit (LEO) altitudes (i.e., below 2,000 kilometers (1,243 miles). Manmade debris consists of material left in Earth orbit from the launch, deployment, and deactivation of spacecraft. It exists at all inclinations and primarily at LEO altitudes of approximately 800 to 1000 kilometers (500 to 625 miles).[18] Orbital and de-orbiting debris moves in many different orbits and directions, at velocities ranging from three to over 75 kilometers per second (1.9 to over 47 miles per second) relative to Earth.[19] Although space debris is not explicitly mentioned in any US legislation, an Executive Branch policy directive, National Space Policy,[20] identifies the following guidance to support major US space policy objectives:

"…the United States shall:

- Lead the continued development and adoption of international and industry standards and policies to minimize debris, such as the United Nations Space Debris Mitigation Guidelines;
- Develop, maintain, and use space situational awareness (SSA) information from commercial, civil, and national security sources to detect, identify, and attribute actions in space that are contrary to responsible use and the long-term sustainability of the space environment;
- Continue to follow the United States Government Orbital Debris Mitigation Standard Practices, consistent with mission requirements and cost effectiveness, in the procurement and operation of spacecraft, launch services, and the conduct of tests and experiments in space;
- Pursue research and development of technologies and techniques, through the Administrator of the NASA and the Secretary of Defense, to mitigate and remove on-orbit debris, reduce hazards, and increase understanding of the current and future debris environment; and
- Require the head of the sponsoring department or agency to approve exceptions to the United States Government Orbital Debris Mitigation Standard Practices and notify the Secretary of State."

3.10.1 Characteristics of Orbital and De-Orbiting Debris

Orbiting objects lose energy through friction with the upper reaches of the atmosphere and various other orbit-perturbing forces. Over time, the object falls into progressively lower orbits and eventually falls to Earth. Once the object enters the measurable atmosphere, atmospheric drag slows it down rapidly and causes it either to burn up or de-orbit and fall to Earth. Satellites

with circular orbital altitudes of less than 400 kilometers (248 miles) may re-enter the atmosphere within a few months, whereas satellites with orbital altitudes greater than 900 kilometers (559 miles) may have lifetimes of 500 years or more.[21]

It is estimated that more than 10,000 objects greater than 4 inches in size, tens of millions of objects between 0.039 and 4 inches in size, and trillions of objects less than 0.039 inch in size are in orbit.[22] Most cataloged orbital debris occur in LEO because most space activity has occurred at those altitudes. LEO occurs at altitudes less than 2,000 kilometers (1,243 miles). The quantity of orbital debris has been growing at a roughly linear rate and growth is projected to continue into the future.[23]

3.10.2 Hazards to Space Operation from Debris

The effects of launch vehicle generated orbital debris impacts on other spacecraft including the Vulcan Centaur vehicle depend on the altitude, orbit, velocity, angle of impact, and mass of the debris. Debris less than about 0.004 inch in diameter can cause surface pitting and erosion. Long-term exposure of payloads to such particles is likely to cause erosion of exterior surfaces and chemical contamination and may degrade operations of vulnerable components. Debris between 0.004 and 0.4 inch in diameter would produce impact damage that can be serious. Objects larger than 0.4 inch in diameter can produce catastrophic damage.[24]

3.11 Geology and Soils

3.11.1 Geology

Geology for VSFB described in the 1998 FEIS Section 3.8.2.1, 2000 FSEIS Section 3.8, incorporated by reference, are still accurate, and circumstances and conditions have not changed in a manner to require a new analysis.

3.11.2 Topography and Soils

Topography and Soils for VSFB described in the 1998 FEIS Section 3.8.2.2, 2000 FSEIS Section 3.8, incorporated by reference, are still accurate, and circumstances and conditions have not changed in a manner to require a new analysis. Reference ***Appendix A, Figure 13. Soil Map.*** for details.

3.12 Transportation

Transportation for SLC-3E VSFB described in the 1998 FEIS Section 4.8.1.2 and 2000 FSEIS Section 3.4, incorporated by reference, are generally accurate, and circumstances and conditions have not changed in a manner to require a new analysis.

3.12.1 Roadways

3.12.1.1 Regional Access

Regional access for SLC-3E VSFB described in the 1998 FEIS Section 3.4.2.1 and 2000 FSEIS Section 3.4, incorporated by reference, are generally accurate. Circumstances and conditions have not changed in a manner as to require a new analysis; however, minor logistics changes are

outlined below. The Vulcan Centaur vehicle and payload components will be transported to VSFB using water.

3.12.1.2 Local Access

Local access for SLC-3E VSFB described in the 1998 FEIS Section 3.4.2.1 and 2000 FSEIS Section 3.4, incorporated by reference, are still accurate, and circumstances and conditions have not changed in a manner to require a new analysis.

3.12.1.3 On-Site Roadways

On-site roadways for SLC-3E VSFB described in the 1998 FEIS Section 3.4.2.1 and 2000 FSEIS Section 3.4, incorporated by reference, are still accurate, and circumstances and conditions have not changed in a manner to require a new analysis.

3.12.2 Railways

Railways for SLC-3E VSFB described in the 1998 FEIS Section 3.4.2.2 and 2000 FSEIS Section 3.4, incorporated by reference, are still accurate, and circumstances and conditions have not changed in a manner to require a new analysis.

3.13 Utilities

Utilities for SLC-3E VSFB described in the 1998 FEIS Section 3.5.2, 2000 FSEIS Section 3.5 and 2003 FEA Section 3.3, incorporated by reference, are still accurate, and circumstances and conditions have not changed in a manner to require a new analysis.

3.13.1 Water Supply

Water for SLC-3E VSFB described in the 1998 FEIS Section 3.5.2.1, 2000 FSEIS Section 3.5 and 2003 FEA Section 3.4, incorporated by reference, are still accurate, and circumstances and conditions have not changed in a manner to require a new analysis.

3.13.2 Wastewater

Wastewater for SLC-3E VSFB described in the 1998 FEIS Section 3.5.2.2, 2000 FSEIS Section 3.5 and 2003 FEA Section 3.4, incorporated by reference, are still accurate, and circumstances and conditions have not changed in a manner to require a new analysis.

3.13.3 Electric Power

Electric Power for SLC-3E VSFB described in the 1998 FEIS Section 3.5.2.4, 2000 FSEIS Section 3.5 and 2003 FEA Section 3.1.1.3, incorporated by reference, are still accurate, and circumstances and conditions have not changed in a manner to require a new analysis.

3.13.4 Stormwater

Stormwater for SLC-3E VSFB described in the 1998 FEIS Section 3.9.2.2 and 2003 FEA Section 3.4.2, incorporated by reference, are still accurate, and circumstances and conditions have not changed in a manner to require a new analysis.

SLC-3E generally drains from the northwest towards the southeast, directed toward the Bear Creek Canyon. Surface water runoff is collected through a series of stormwater structures, culverts, swales and surface flow and conveyed to the concrete deluge water basin in the southeast corner of the SLC-3E.

3.14 Department of Transportation Act Section 4(f) Properties

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

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

The ROI for Section 4(f) is defined by the noise footprint of the Proposed Action (see Figures 9 through 12).

Potential Section 4(f) properties within the ROI include Jalama Beach County Park, Surf Beach, County of Santa Barbara Ocean Beach Park, Miguelito Park, Rancho Guadalupe Dunes County Park, Point Sal Beach State Park, Gaviota Beach State Park, and the Channel Islands National Park (see Figure 16). Surf Beach, Ocean Beach, and Jalama Beach are closest to SLC-3E. Surf Beach is located north of SLC-3E at the end of Ocean Avenue. This is the only public access beach on VSFB and is the site of the Lompoc-Surf Station Amtrak stop for the Pacific Surfliner. Areas north and south of the beach are closed March through September for western snowy plover nesting season. From October to February, the beach is accessible by walking from Ocean Beach County Park, which is located north of SLC-3E. Ocean Beach County Park 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. Jalama Beach County Park is located southeast of SLC-3E. 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.

Miguelito Park offers hiking trails, playground, horseshoes, BBQ grills, and group picnic area. The park is small and located inland of SLC-3E, outside of any noise contour. The Rancho Guadalupe Dunes County Park is situated north of SLC-3E and VSFB. It is outside of any noise contour. The park contains miles of pristine sand dunes and sensitive plants and animals such as western snowy plover and California least tern. Point Sal Beach State Park is located to the north of SLC-3E on VSFB, outside of any noise contour. Recreational activities at the beach include fishing, beach combing, hiking, nature study, photography, picnicking and sunbathing. Swimming is not recommended. Gaviota Beach State Park is located southeast of SLC-3E and VSFB, outside of any noise contour. The state park offers camping and beach activities.

The Channel Islands National Park is within the sonic boom footprint (see Figure 12). There are no services such as food or gear stores or rental shops on the five islands off of the west coast. Activities on the island include hiking, camping, snorkeling, kayaking, whale watching, birdwatching, and taking photographs, among others.

3.15 Socioeconomics

As of 2018, VSFB had a population of 3,379 with a median household income of $63,777.[25] The influence of VSFB and its launch programs on population and employment primarily lie within Santa Barbara County, which has a population of 423,947. The closest affected City is Lompoc, with a population of 42,438.[26] Approximately 6,700 (16%) of Lompoc's citizens are employed at VSFB according to the City of Lompoc[27] website.

Construction activities are expected to employ less than 100 personnel over an 18-month duration. The presence of these temporary and permanent employees causes a chain of economic reactions throughout the local region and nearby counties. Encouraging commercial space launch companies such as ULA to expand VSFB existing launch capabilities ensures continuation of positive impacts on Santa Barbara County and the surrounding area's economics.

Environmental justice is defined by the EPA as "The fair treatment and meaningful involvement of all people regardless of race, color, national origin or income with respect to the development, implementation, and enforcement of environmental laws, regulations, and policies."

Title 32 CFR Part 989.33, *Environmental Justice* and AFI 32-7061, *EIAP* require that a project proponent comply with EO 12898, *Federal Actions to Address Environmental Justice in Minority Populations and Low-Income Populations*. The EO requires Federal agencies to identify and address, as appropriate, disproportionately high and adverse human health or environmental effects of their programs, policies, and activities on minority and low-income populations and to ensure that these types of impacts are considered in EAs and other environmental documents. DOT Order 5610.2(a), *Final DOT Environmental Justice Order*, requires FAA to analyze impacts on low-income and minority populations.

The 2010 Census of Population and Housing reports numbers of minority residents. Minority populations included in the census are identified as Black or African American, American Indian and Alaskan Native, Asian, Native Hawaiian/Other Pacific Islander, Hispanic or Other. Based upon the 2010 Census of Population and Housing, Santa Barbara County had a population of 543,376 persons. Of this total, 122,022 persons, or 22.5 %, were minority. Orange County had a population of 1,145,956 persons. Of this total, 686,080 persons or 59.9% were minority. The largest segment of the minority population is Hispanic at 26.9%.[28]

4 Environmental Consequences

This section describes the potential environmental impacts associated with the Proposed Action and No Action Alternative. Components of the affected environment that are of greater concern are described in greater detail.

Guidelines established by the CEQ (40 CFR 1508.27) specify that significance should be determined in relationship to both context and intensity (severity). The assessment of potential impacts and the determination of their significance are based on the requirements in 40 CFR 1508.27. The three levels of impact are:

- No Impact - No impact is predicted
- No Significant Impact - An impact is predicted, but the impact does not meet the intensity/context significance criteria for the specific resource
- Significant Impact - An impact is predicted that meets the intensity/context significance criteria for the specific resource

Factors contributing to the intensity or severity of the impact include the following:

- The degree to which the action affects public health or safety;
- Unique characteristics of the geographic area such as proximity to cultural resources, park lands, prime farmlands, wetlands, wild and scenic rivers or ecologically critical areas;
- The degree to which effects of the action on the quality of the human environment are likely to be highly uncertain or controversial;
- The degree to which the action may establish a precedent for future actions with significant effects or represents a decision in principle about a future consideration;
- Whether the action is related to other actions with individually insignificant, but cumulatively significant impacts;
- The degree to which the action may adversely affect an endangered or threatened species or its habitat that has been determined to be critical under the ESA.

Fifteen (15) environmental aspects are analyzed to assess potential impacts of the Proposed Action and No Action Alternative: Land Use, Noise, Biological Resources, Historical and Cultural Resources, Air Quality, Climate, Orbital and De-Orbiting Debris, Hazardous Materials and Solid and Hazardous Waste, Water Resources, Geology and Soils, Transportation, Utilities, Health and Safety, Socioeconomics, Environmental Justice and Department of Transportation Act Section 4(f) Properties. Thresholds for determining impact significance are based on the applicable compliance standard, Federal or State recommended guidance or professional standards/best professional judgment. In addition, the FAA uses thresholds that serve as specific indicators of significant impact for some impact categories. FAA actions that would result in impacts at or above these thresholds require the preparation of an EIS, unless impacts can be reduced below threshold levels. Quantitative significance thresholds do not exist for all impact categories; however, consistent with the CEQ Regulations, the FAA has identified factors that should be considered in evaluating the context and intensity of potential environmental impacts (FAA Order 1050.1F, Paragraph 4-3.3 and Exhibit 4-1). Because the FAA may adopt this SEA to support its environmental review of ULA's license application(s), the FAA's significance thresholds are considered in the assessment of potential environmental consequences in this EA.

4.1 Biological Resources

Per FAA Order 1050.1F, impacts would be significant if the USFWS or the NMFS determines that the action would be likely to jeopardize the continued existence of a Federally-listed threatened or endangered species or would result in the destruction or adverse modification of Federally-designated critical habitat.

As stated in Section 3.1.5, SLD 30 conducted programmatic ESA consultation with the USFWS in 2015 for routine mission operations, including launches, and maintenance activities at VSFB. The USFWS issued a PBO, which determined that the actions covered in the consultation would not jeopardize the continued existence of any federally listed species or destroy or adversely impact any critical habitat. All actions within the SEA are covered by consultations under the 2015 PBO.

The USSF is committed to the long-term management of all-natural areas on its installations, as directed by the Sikes Act and AFMAN 32-7003, *Environmental Conservation*, 20 April 2020. Long-term management objectives are identified in SLD 30's INRMP, with specific land-management objectives such as wetland protection, conservation of threatened and endangered (T&E) species, and habitat restoration.

Any operation that may affect Federally-listed species or their critical habitats involves consultation with the USFWS under Section 7 of the ESA of 1973 (as amended). The Marine Mammal Protection Act of 1972 also prohibits the "take" of marine mammals. Take is defined as "to harass, hunt, capture, or kill, or attempt to harass, hunt, capture, or kill any marine mammal." Thus, the Air Force may be required to consult with the NMFS. The NMFS is also responsible for evaluating potential impacts to Essential Fish Habitat (EFH) and enforcing the provisions of the 1996 amendments to the Magnuson-Stevens Fishery Conservation and Management Act (MSFCMA).

In April of 2019, SLD 30 CES/CEIEA Natural Resources reviewed the description of ULA's proposed Vulcan Centaur Program and determined ULA's proposed action is consistent with the PBO and historical activities at SLC-3E, and that an ESA consultation for potential effects to ESA-listed species was not required. VSFB and ULA will comply with all relevant terms and conditions in the PBO, including avoidance and minimization measures and reporting requirements, during Vulcan Centaur Program launches at SLC-3E.

Specific requirements are identified in ***Table 4-1: Summary of Requirements to Protect Biological Resources*** would be used to minimize impacts to biological resources. Launches are exempt from the MBTA under military readiness activities. Military readiness activity, as defined in Section 315(f), includes all training and operations of the Armed Forces that relate to combat, and the adequate and realistic testing of military equipment, vehicles, weapons, and sensors for proper operation and suitability for combat use. 50 C.F.R. § 21.15 requires us to confer and cooperate with USFWS to develop and implement appropriate conservation measures to minimize or mitigate" significant adverse effects.

Table 4-1: Summary of Requirements to Protect Biological Resources

Law or Rule	Permit/Action(s)	Requirement	Agency or Organization
Endangered Species Act (ESA)	Consultation with USFWS and NMFS to determine no effect or not likely to	Conserve ecosystems that support T&E species. The PBO and Section 7 requires federal	USFWS

Law or Rule	Permit/Action(s)	Requirement	Agency or Organization
	adversely affect some T&E species. Determine if species under USFWS jurisdiction are impacted.	agencies to ensure that any action authorized, funded or carried out by them is not likely to jeopardize the continued existence of listed species or modify critical habitat.	
Magnuson-Stevens Act	Consultation with NMFS to determine no impact or no significant adverse impact	Conserve/protect EFH. federal agencies must ensure that any action authorized, funded or carried out by them will not adversely impact EFH otherwise mitigation will be required	NMFS
EO 11988	SLC-3E is not located within the 100-year floodplain. No construction is proposed within the 100-year floodplain.	Reduce the risk of flood loss, minimize the impact of floods on human safety, health and welfare, and restore and preserve the natural and beneficial values served by floodplains. Consider alternatives to avoid adverse effects in the floodplains. Prepare Finding of No Practicable Alternative (USSF)	DoD
EO 11990	Directs each federal agency to provide leadership and take action to minimize destruction, loss or degradation of wetlands	Minimize loss, destruction or degradation of wetlands and restore and preserve the natural and beneficial values served by wetlands. Consider alternatives to avoid adverse effects to wetlands. Prepare a Finding of No Practicable Alternative (USSF)	DoD
EO 13112	Remove and control invasive species	Prevent the introduction of invasive species and provide for their control and minimize the economic, ecological, and human health impacts that invasive species cause.	DoD
Migratory Bird Treaty Act (MBTA)	Confer with USFWS as necessary and comply with applicable permits	Prohibits harassment or harm to migratory birds, and destruction of the eggs or nests without a permit.	USFWS
AFMAN 32-7003	Long-term management of all-natural areas on the Installation	Protect listed species, biodiversity, wetlands.	DoD

4.1.1 Proposed Action

Potential impacts to Biological Resources due to the Proposed Action include construction, launch operations and launch impacts. No State or Federally-listed T&E plant species have been documented in the Proposed Action area. The Gaviota tarplant (*Deinandra increscens ssp. villosa*) is a Federally and State of California listed endangered plant which, in 2010, was observed near Tranquillon Peak, approximately 4.5 miles southeast of SLC-3E. Beach layia (*Lavia camosa*) is a Federally and State of California listed endangered plant and occurs within the coastal dune scrub habitat of VSFB. Other vegetation commonly associated with VSFB is the California sagebrush (*Artemisia californica*), coastal buckwheat (*Eriogonum parvifolium*),

black sage (*Salvia mellifera*), silver lupine (*Lupinus chamissonis*), deerweed (*Lotus spp*.), and poison oak (*Toxicodendron diversilobum*).

4.1.1.1 Construction Impacts

Potential impacts to biological resources during the construction would be minor. Exterior construction occurs within the SLC-3E previously disturbed perimeter boundary and shoulders of existing roadways. Other than the common "startle response," no impacts to wildlife (including Federally and State-listed wildlife species) due to construction noise are anticipated to be similar to the 2003 FEA.

Vulcan Centaur construction activities will have no significant impact on Biological Resources.

4.1.1.2 Operations Impacts

Potential impacts to biological resources during launch preparations would be minor. Other than the common "startle response," no impacts to wildlife (including Federally and State-listed wildlife species) due to the noise of daily operations are anticipated.

Vulcan Centaur launch preparation and operation activities will have minimal impact on Biological Resources, similar to the 2003 FEA. There will be no significant impacts.

4.1.1.3 Launch Impacts

4.1.1.3.1 Vegetation

Vulcan Centaur launches will have some impacts near the launch pad associated with fire and acid deposition similar to previous actions at VSFB. No reports of scorched vegetation outside the fence due to Atlas V launches were found. Since the Vulcan Centaur is a larger vehicle than Atlas V, the Proposed Action would impact the vegetation in an area no larger than the areas impacted by a Delta IV Heavy or Titan, both are as large as or larger than the Vulcan Centaur. Past vegetation scorching has not permanently affected the vegetation near the LCs, and this is expected to apply to Vulcan Centaur launches.

Acid deposition is primarily associated with SRMs. Vulcan Centaur configurations will include zero, two, four or six Orbital ATK GEM-63XL SRMs. Atlas V Vehicles can be configured with up to five Rocketdyne's AJ-60A SRMs. Delta IV Vehicles can be configured with up to four Orbital ATK GEM-60 SRMs. The GEM-60 SRMs are in the same family as the proposed Vulcan Centaur GEM-63XL SRMs.

Acid and particulate deposition for Delta launches has extended less than 0.6 miles from the launch pad and affected relatively small areas (up to 114 acres). Continuous acid deposition did not exceed 0.6 miles from the launch pad for Titan launches. However, isolated acid deposition has occurred up to 5.8 miles from the launch pad under certain meteorological conditions. Titan launches used approximately twice the solid propellant compared to the six SRM Vulcan Centaur variant.

The 2000 SEIS analyzed potential impacts to the environment from the five Atlas V SRMs and the GEM-60 Delta IV SRMs, including deposition to wetlands, and determined no significant environmental impacts are expected to occur. The SEIS noted that increased use of SRMs would result in larger and more frequent hydrochloric acid (HCl) ground clouds from the increased use of SRMs, temporarily affecting flora and fauna. The SEIS concluded that the effects of HCl and

aluminum oxide (Al_2O_3) deposition from SRMs would be minimal and that plant species are expected to recover from short-term launch impacts. Acid and particulate deposition for the Proposed Action would be slightly greater than current Atlas V deposition due to anticipated use of greater quantities of solid propellants. However, Vulcan Centaur use of solid propellants is less than past Titan use. Acid and particulate impacts of the Proposed Action on vegetation is expected to be minimal with recovery of short-term launch impacts expected.

An anomaly on the launch pad would present potential impacts to biological resources from the possibility of extreme heat and fire, percussive effects of the explosion and debris that might impact land or surface waters. The 2000 SEIS concluded that damaged vegetation resulting from a launch anomaly would be expected to regrow within the same growing season because no lingering effects would be present. Similar results are expected for Vulcan Centaur launch anomalies.

The nearest Gaviota tarplant is approximately 4.5 miles southeast of SLC-3E, near Tranquillon Peak. Due to the distance and typical meteorological conditions, acid deposition is not expected to affect Gaviota tarplant habitat, so no further evaluation is not required.

ULA will monitor the beach layia population for the first two launches of new programs at existing facilities that use solid rocket motors or boosters that could affect existing layia individuals. Monitoring will include:

- testing for acid cloud deposition on layia or within the habitat using strips of pH paper during the launch event, or
- conducting pre- and post-launch monitoring for stippling of leaves, necrotic lesions, and general plant vigor of layia, or plants with similar morphological characteristics within the habitat if individual layia plants are absent.

If adverse impacts occur, appropriate mitigation measures will be developed in coordination with SLD 30 CES/CEIE and USFWS.

4.1.1.3.2 Wildlife and Marine Life

No animal mortality has been observed at VSFB that could be attributed to Delta, Atlas or Titan launches.[29] Similar results are expected for Vulcan Centaur Program launches. Post launch monitoring conducted on previous launches, and previous environmental analyses concluded that launch impacts to wildlife species are minimal and not expected to have residual effects past each launch operation. The closest pinniped haul out locations to SLC-3E are North and South Rocky Point, approximately 0.6 and 0.8 miles to the southwest, respectively. The behavior of scrub-jays observed after Delta, Atlas and Titan launches has been normal, indicating no noise-related effects. ULA will adhere to the Letter of Authorization, ***Appendix D***, under 50 CFR Part 217, Subpart G – Taking of Marine Mammals Incidental to Rocket and Missile Launches and Aircraft Operations at VSFB.

An anomaly on the launch pad would present potential impacts to biological resources from the possibility of extreme heat and fire, percussive effects of the explosion and debris that might impact land or surface waters. The explosion could injure or kill wildlife found adjacent to the launch pad or within debris impact areas. Potential fires started from the anomaly could result in a temporary loss of habitat and mortality of less mobile species.[30]

During a nominal launch, the launch vehicle and spacecraft would be carried over the coastal waters of the Pacific Ocean and through the Earth's atmosphere. When expended, the SRMs and booster disengage and fall into the Pacific Ocean. The payload fairings separate, re-enter the Earth's atmosphere and fall into the Pacific Ocean. The Centaur upper stage delivers the payload into orbit. The Vulcan Centaur plans no recovery of any segments.

With more than 75 Atlas V launches (as of March 2018) with no complete failures, Atlas V is among the most reliable launch vehicles in the world. Although no reliability data for the Vulcan Centaur Program exists, similar EELVs typically have a reliability of approximately 95 percent. Thus, it is unlikely that a launch vehicle or payload would impact land surface or the ocean.

An improbable mishap downrange would occur over the open ocean and would not likely jeopardize any marine life, given the relatively low density of species within the surface waters of these open ocean areas. Debris from launch failures has a small potential to adversely affect managed fish species and their habitats in the vicinity of the project area. However, after 1998 EIS EELV consultation with the NMFS, the Air Force found "no greater than minimal adverse effects" to EFH under NMFS regulations.[31]

If an early launch abort or failure happens, spacecraft and launch vehicle debris would fall onto land surface or into the ocean and cause potential impacts. Launch vehicle debris from a liquid propellant vehicle is considered a negligible hazard because virtually all hazardous materials are consumed in the destruct action or dispersed in the air and only structural debris would strike the water. In a destruct action, the Vulcan Centaur vehicle may survive, essentially intact, to impact the water. This would present some potential for habitat impact if the spacecraft contains hypergolic propellants or other chemicals that are toxic to marine organisms. This SEA compared the anticipated Vulcan Centaur biological resource impacts to the current Atlas V biological resource impacts as documented in the November 2011 *Environmental Assessment for Launch of NASA Routine Payload.*[32] The analysis determined that the anticipated Vulcan Centaur biological resource impacts are within the scope of the 2011 NASA Routine Payload EA and are therefore categorically excluded from this NEPA evaluation. If future, unanalyzed payloads or launch vehicle configurations pose potential environmental consequences, separate NEPA evaluation(s) will be performed for each unique payload program or launch vehicle configuration, as required.

On VSFB, Pacific harbor seals (*Phoca vitulina richardsi*), California sea lions (*Zalophus californianus*), and Northern elephant seals (*Mirounga angustirostris*) regularly occupy the rock outcrops and protected coves near Minuteman Beach, Purisima Point and between Point Arguello and the Boat House. Steller sea lions (*Eumetopias jubatus*) are also occasionally observed near Point Arguello. On the Northern Channel Islands, these species use many haulout locations, often in large numbers, along with northern fur seals (*Callorhinus ursinus*) and occasional occurrences of Guadalupe fur seals (*Arctocephalus townsendi*).

Monitoring of previous sonic booms has 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. Under the Marine Mammal Protection Act, the NMFS issued a Final Rule for taking marine mammals incidental to USAF and USSF launches and a Letter of Authorization (LOA). The LOA allows launch programs to unintentionally take small numbers of marine

mammals during launches. VSFB is required to comply with the conditions listed in the LOA and address NMFS concerns regarding marine mammals at VSFB and the Northern Channel Islands. Under the LOA, monitoring of marine mammals at VSFB and the Northern Channels Islands is required during launches, and this will include the Vulcan Centaur launches that are expected to occur as part of the Proposed Action. Given the authorizations in place and the required monitoring, the Proposed Action would not result in significant impacts on pinnipeds.

Sonic booms created by launches from VSFB LCs occur over the open Pacific Ocean. The effects of a sonic boom on whales or other open ocean species are not known. Because these sonic booms are infrequent, the marine species in the ocean's surface waters are present in low densities (although spring and fall migration would see periodic groups of migrating whales that follow the coastline), and the sonic boom footprint lies over 42 miles from VSFB, the sonic booms from launches are not expected to negatively affect the survival of any marine species.[33]

Noise monitoring of previous launches at VSFB has 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. Under the Marine Mammal Protection Act, the NMFS issued a Final Rule for taking marine mammals incidental to USSF launches and a Letter of Authorization. The Letter of Authorization allows launch programs to unintentionally take small numbers of marine mammals during launches. VSFB is required to comply with the conditions listed in the Letter of Authorization and address NMFS concerns regarding marine mammals at VSFB and the Northern Channel Islands. Under the Letter of Authorization, monitoring of marine mammals at VSFB and the Northern Channels Islands is required during launches, and this will include the Vulcan Centaur Program launches that are expected to occur as part of the Proposed Action. Given the authorizations in place and the required monitoring, the Proposed Action would not result in significant impacts on pinnipeds.

ULA will monitor acid deposition for the first two launches of any new launch vehicle or program with potential to impact red-legged frog. The USSF will test for acid deposition by conducting pre- and post-launch pH monitoring. If adverse impacts occur, ULA will develop appropriate mitigation measures in coordination with the USSF. Vulcan Centaur launches will have no significant impact on wildlife and marine life resources.

4.1.2 No Action Alternative

Under the No Action Alternative, the Vulcan Centaur Program would not be implemented. Impacts to Biological Resources, T&E species, or wildlife and marine habitat would remain the same as currently imposed by the Atlas V program. The 1998 FEIS, 2000 FSEIS and 2003 FEA concluded that impacts to vegetation and wildlife would be minimal.

4.2 Air Quality

The ROI for air quality includes all of VSFB and Santa Barbara County, including both lower and upper atmospheres. Per FAA Order 1050.1F, impacts would be significant if the action would cause pollutant concentrations to exceed one or more of the CAAQS, as established by the Environmental Protection Agency under the Clean Air Act, for any of the time periods analyzed, or to increase the frequency or severity of any such existing violations.

4.2.1 Proposed Action

Air emissions from the Proposed Action include construction emissions, operations emissions and launch emissions. The Vulcan Centaur Program introduces no listed chemicals at or above CAA RMP reportable thresholds and will not require preparation of an RMP.

4.2.1.1 Construction

Air emissions from construction activities (described in Section 2.1) would cause a minor increase in PM emissions due to demolition, excavations, minor clearing, construction vehicles and diesel generators. Carbon dioxide would be released by fossil fuel powered equipment and vehicles. Diesel-powered equipment would emit CO, hydrocarbons, NOx and CO_2. Emissions are expected to be minor from these sources over the expected 18 months of construction. Construction activities are not expected to significantly change regional (Santa Barbara County) or local (VSFB) air emissions. No CAAQS exceedances are expected during construction.

Criteria pollutant emissions associated with construction and demolition activities at SLC-3E and offsite roadways, described in Section 2.1, were calculated using Air Conformity Applicability Model (ACAM), version ACAM06252019 based on the anticipated construction schedule of 18 months and the types of construction activities including demolition, site grading, trenching, building modification, architectural coatings and paving. This ACAM analysis was performed in accordance with the Air Force Manual 32-7002, Environmental Compliance and Pollution Prevention; the Environmental Impact Analysis Process (EIAP, 32 CFR 989); and the General Conformity Rule (GCR, 40 CFR 93 Subpart B). If the estimated emissions are less than the screening thresholds, then the emissions are considered not to have the potential to lead to an exceedance of the NAAQS or CAAQS. ***Table 4-2: Vulcan Centaur Construction Emissions at VSFB, (TPY)*** represents the first year and most intensive construction and demolition activity and would not exceed thresholds for any criteria pollutant. During construction and demolition activities, dust mitigation measures would be implemented as required by the State of California's 1979 Air Quality Attainment Plan.

Table 4-2: Vulcan Centaur Construction Emissions at VSFB, (TPY)

Pollutant	Emissions	Threshold	Exceed Threshold?
VOC	0.775	250	No
PM	3.528	250	No
NO_X	2.88	250	No
SO_X	0.011	250	No
CO	4.922	210	No
Lead	0.0	25	No
*Reference **Appendix E** for ACAM Record of Air Analysis Summary and Detail Reports*			

4.2.1.2 Launch and Operation

Proposed Action air emissions from Vulcan Centaur launch preparations and operations include PM, VOC, NOx, SOx, HAPs and CO_2/CO from sources such as:

- Fugitive emissions due to road dust or modification of existing facilities
- Vehicle, mobile equipment emissions
- Battery charging emissions
- Surface coating launch structures, ground support equipment, other equipment and structures
- Sandblasting, hand-sanding of launch structures, ground support equipment, other equipment and structures
- Engine-driven electrical emergency generators
- Diesel fuel storage tanks for emergency generators
- Diesel powered mobile search lights for launches
- Hydrogen flare stack
- LNG, LN_2, LO_2, LH_2 storage and supply fugitive emissions
- Minor coating, painting
- Isopropyl Alcohol flush carts
- Fugitive emissions from hand-wipe cleaning, application of adhesives, and other maintenance activities.

Daily operations and support personnel for the Vulcan Centaur Program would be consistent with current Atlas V Program and are not anticipated to increase emissions.

The Vulcan Centaur launch vehicle is considered a mobile source and is not subject to Federal, State or local air permitting. The Vulcan Centaur vehicle uses two BE-4 LNG LO_2 engines. Primary BE-4 engine combustion products are carbon dioxide, CO and water vapor; minor combustion products are NOx, methane (CH_4), nitrous oxide (N_2O), volatile organic compounds (VOCs); and trace amounts of SOx and PM are produced. Most of the CO is oxidized to carbon dioxide during afterburning in the exhaust plume; therefore, the Proposed Action would not result in exceeding any NAAQS.

New LNG flare stack system would require a Permit to Operate and a New Source Review. The Vulcan Centaur Program will be eliminating a currently permitted RP-1 and replacing it with the LNG flare stack system. The quantity of LNG is larger than the current quantity of RP-1. However, LNG burns significantly cleaner than RP-1; therefore, certain pollutants are expected to decrease with the removal of RP-1. ULA uses no ozone-depleting substances (ODS) in launch operations support. Vulcan Centaur launch preparation and operations support emissions are expected to be similar to the Atlas V with slight increases to overall VSFB emission criteria as detailed in ***Table 4-3***. Thus, Proposed Action operations, even at a higher launch rate, emissions are not expected to significantly change the existing air emissions on VSFB. No CAAQS exceedances during operations are expected. New air emission impacts in the lowest 3,000 feet of atmosphere are associated with the Vulcan Centaur Program new LNG system and include flaring of LNG during vehicle loading and unloading and launch operations. The new potential to emit and relative percent increase to VSFB's current PTE totals are shown in ***Table 4-3: Vulcan Centaur PTE and Percent Increase at VSFB, (TPY)***.

Table 4-3: Vulcan Centaur PTE and Percent Increase at VSFB, (TPY)

Pollutant	Existing VSFB PTE	Vulcan Centaur Project PTE	% Increase
VOC	50.87	0.198	0.39
PM	13.19	0.409	3.10
NO_X	163.13	1.392	0.85
SO_X	6.25	0.003	0.05
CO	71.55	6.365	8.90
Note: ULA will be responsible for obtaining new or modifying existing regulated emission source permits, separate from VSFB's regulated emissions. Table 3-3 shows relative percent increase for comparison purposes only and does not intend to modify any of VSFB's regulated emissions.			

SRMs also produce air emission during launch. ***Table 4-4: Launch Emissions from Vehicles using SRMs*** contains the criteria pollutants and HCl (HAP) emissions for Atlas V and Delta IV SRM launches. Aluminum oxide emissions are included in PM_{10} emissions.

Table 4-4: Launch Emissions from Vehicles using SRMs

Vehicle	First Stage Propellants	Air Emissions, Tons per Launch, into Lowest 3000 feet of Atmosphere					
		VOC	NOx	CO	SO_2	PM_{10}	HCl
Atlas V (551/552)	RP-1 / LO_2	0	1.1	0.01	0	15	7.8
Delta IV Medium +	LH_2 / LO_2	0	0.71	0.0054	0	10	5.1
Source[34]							

Air emissions from Vulcan Centaur launches with SRMs are expected to be similar to the Atlas V (551/552) or Delta IV launches with SRMs. The largest SRM configuration for Atlas V uses five GEM63 SRM, and the largest SRM configuration for Vulcan Centaur uses six GEM63XL. Assuming similar SRM combustion rates and launch vehicle ascent rates, the overall Vulcan Centaur per launch emissions are expected to be similar to the current Atlas V launch emissions, and based on SRM quantity ratios, aluminum oxide, as PM_{10}, and HCl emissions would increase less than 20 percent from Atlas V (551/552) launch configurations.

BE-4 engine combustion produces gases and particles, such as N_2O, NO_x, water vapor (H_2O), and hydrogen oxides, reduce stratospheric ozone concentrations locally and globally. N_2O is now the largest anthropogenic ozone-depleting emission since the prohibitions on chlorofluorocarbons. H_2O is not highly reactive but, in certain chemical reactions, creates radicals that destroy ozone. SRM emissions contain aluminum oxide, NOx, chlorine compounds and small amounts of highly reactive radical compounds that deplete ozone in the plume wake immediately following launch. Particulate emissions may also enable reactions creating radicals that deplete ozone concentrations. The March 2000 *Final Supplemental Environmental Impact Statement (SEIS) for the EELV Program* noted that a conservative estimate of the yearly EELV contribution to the total annual global ozone decrease, based on the maximum expected launches of vehicles with SRMs, is less than 0.1 percent of existing conditions. This constitutes an insignificant decrease in global ozone. Neither the BE-4 engine nor SRM emissions contribute significantly to stratospheric ozone depletion.

The potential for an accidental release of fuels or other hazardous liquids would be minimized by adherence to ULA safety and operating procedures. All spills would be managed per the existing VSFB spill response plan and the ULA ICP.

Airspace closures associated with launches would result in additional aircraft emissions primarily from aircraft being re-routed and subsequently expending additional fuel. However, emissions from aircraft being re-routed would occur above 3,000 feet (the mixing layer) where NAAQS would not be applicable; therefore, no impact to air quality would occur from aircraft re-routing from airspace closures.

With regards to potential departure delays, airspace-related impacts could increase up to a maximum of three times per year; however, only a negligible amount of emissions would be generated from any aircraft departure delays associated with launches. Therefore, any air emissions increase from departure delays are not expected to result in an exceedance of a NAAQS for any criteria pollutant. Emissions from aircraft being re-routed would occur above 3,000 feet and thus would not affect ambient air quality. Therefore, airspace closures associated with launches are not expected to result in significant air quality impacts.

4.2.1.3 Climate

The effects on climate of the Proposed Action or the No-Action Alternative covers the potential effects of currently understood climate change issues. The CEQ specifically asked agencies in 2016 to consider:

The potential effects of a proposed action on climate change as indicated by its greenhouse gas (GHG) emissions

The implications of climate change for the environmental effects of a Proposed Action.

GHG trap heat in the atmosphere. Increasing global temperatures trending over the past century have been scientifically correlated to increasing GHG emissions due to human activities. Climate change induced by global warming may result in rising sea levels, more severe weather events, loss of habitat and economic and socio-political effects such as reduced food security.

4.2.1.4 Proposed Action

Generation of GHG emissions from construction and launch preparation and daily operations include CO_2 generation from vehicles and fugitive methane emissions. These emissions are insignificant compared to total US GHG emissions.

Vulcan Centaur launches emit GHGs CO_2, water vapor, NOx, CH_4 and N_2O. Annual GHG emission associated with the Proposed Action operations are compared to US 2011 GHG emissions (EPA, 2013) and the 2011 global CO_2 emissions in ***Table 4-5: Estimated CO2 Emissions***. Emissions of GHGs from the Proposed Action alone would not cause any appreciable global warming that may lead to climate change. However, these emissions would increase the atmospheric concentration of GHGs. At present, no methodology exists that would enable estimating the specific impacts that this increment of warming would produce locally or globally. The impact to the climate would still not be significant.

Table 4-5: Estimated CO_2 Emissions

Annual Emissions Source	Metric Tons CO_2 per Year
Global Total CO_2 Emissions	$3{,}400 \times 10^7$
US 2010 Total GHG Emissions	$6{,}821.8 \times 10^6$
Proposed Action GHG Emissions	70

Source[35]

Compared to VSFB totals, Proposed Action GHG emissions would be essentially unmeasurable and not have a climate change impact.

Airspace closures associated with launches would result in additional aircraft emissions mainly from aircraft being re-routed and expending more fuel. These emissions include CO2, which is a GHG. Based on ULA's proposal, airspace-related impacts could increase up to a maximum of three times per year. The amount of time that affected aircraft spend being re-routed would be short-term. In addition, the number of aircraft that would be impacted per launch would not be expected to produce additional emissions that would have a notable impact on climate. Therefore, the increases in GHGs caused by short-term airspace closures during launches is not expected to result in significant climate-related impacts.

4.2.2 No Action Alternative

Under the No Action Alternative, GHG emissions would revert to the existing Atlas V GHG emissions, which would essentially be unmeasurable and not have a climate change impact.

4.3 Historical and Cultural Resources

In December 1992 the entire SLC-3 complex was determined eligible for the NRHP by the USSF 30 SW, in consultation with the State Historic Preservation Office (SHPO) under Criteria A and C as an important asset in the Cold War Era.

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

Cultural resources would be adversely affected if the Proposed Action would cause loss of the value or characteristics that qualify the resource for listing on the NRHP, or if the Proposed Action substantially alters the natural environment or access to it in such a way that traditional cultural or religious activities are restricted. The Proposed Action will comply with all relevant authorities governing cultural resources, including Section 106 of the NHPA and AFMAN 32-7003. SLD 30 of the United States Space Force requires archaeological and Native American monitoring during construction through or adjacent to any known archaeological site, regardless

of a site's NRHP eligibility. Archaeological and Native American monitoring is also typically required in areas where buried sites are possible.

If previously undocumented cultural resources are discovered during construction activities, the extent and significance of the discovery will be initially assessed by a qualified archaeologist. Recommendations for appropriate treatment of the discovery will be developed in consultation with the VSFB cultural resources manager and the Native American representative.

4.3.1 Proposed Action

SLD 30 Cultural Resources Manager evaluated the areas impacted by Proposed Action, and no historical or cultural resource issues were found within the boundaries of SLC-3E and proposed roadway modifications; however, the proposed modifications to existing roadway infrastructure, as described in Section 2.1.2.2, and Building 945, as described in Section 2.1.2.1, have the potential to impact historical or cultural resource.

SLD 30 consulted with the Santa Ynez Band of Chumash Indians (SYBCI), a federally recognized tribe, pursuant to Section 106 of the National Historic Preservation Act (NHPA) of 1966 (54 U.S.C. 306108), as amended, and its implementing regulation found at 36 CFR Part 800. VSFB sent letter USAF_2020_1007_001 to the SYBCI informing them of the Proposed Action on August 30, 2021, included as ***Appendix F***. The letter describes the archaeological investigation locations and methodology conducted by Applied Earthworks on August 18, 19 and 26, 2020 and their conclusion that no prehistoric or historical archaeological materials were observed during the investigation. The SYBCI representative, Sam Cohen, concurred in writing "that the effort to identify cultural resources within the action areas is satisfactory" on September 2, 2021.

SLD 30 consulted with the State Historic Preservation Officer (SHPO) regarding the Proposed Action in compliance with Section 106 of the NHPA.

The Department of Parks and Recreation Office of Historic Preservation State Historical Resources Commission replied to SLD 30 initial consultation, as cited below, and included as ***Appendix F***.

> *To accommodate the launch of the Vulcan Centaur Launch Program, the USAF* (now USSF) *is proposing to modify Space Launch Complex 3-East. Project components include the installation of a pre-constructed fixed launch platform, modifications to Building 945 (Solid Motor Building) increased capacity of mobile service tower and the addition of a liquid natural gas system.*
>
> *Constructed in approximately 1975, Building 945 was formally determined not eligible for National Register of Historic Places (NRHP) inclusion. Archeological sites CA-SBA-534, and 549 were formally determined eligible for the NRHP and although they will not be affected by propose project activities, the USAF determined their proximity to the project area necessitates the presence of an archaeological monitor and will consult with the Santa Ynez Band of Chumash Indians to determine whether a Native American monitor will also be required.*

The USAF are requesting concurrence with its delineation of the project's area of potential effects (APE) and its finding of no historic properties affected. Upon review of the information provided, the SHPO offers the following comments:

1. *Pursuant to 36 CFR Part 800.4(a)(1), the SHPO does not object to the USAF's APE definition.*
2. *The SHPO concurs that a finding of no historic properties affected is appropriate. Be advised that that under certain circumstances, such as an unanticipated discovery or a change in project description, the USAF may have future responsibilities for this undertaking under 36 CFR Part 800.*

No prehistoric resources would be adversely affected by the proposed infrastructure improvements associated with the Vulcan Centaur Program; therefore, no mitigation measures would be necessary.

In the early 1990's, the Atlas II project at SLC-3 was considered an adverse effect to the historic property; resulted in a Historic American Buildings Survey (HABS), Historic American Engineering Record (HAER) and Memorandum of Agreement in 1993; and concluded "the HABS/HAER recordation of SLC-3 has satisfactorily taken into account the effects of the undertaking on SLC-3, and that no other measures to minimize or mitigate the effects of the undertaking on SLC-3 are required." Reference the 2003 FEA, Section 4.3 for additional details. Because the impacts to SLC-3E from the Vulcan Centaur Program are not anticipated to exceed those that were proposed under the EELV program, no additional effort to minimize or mitigate the impacts would be necessary. However, the site remains eligible for listing in the NRHP.

Routine operations involving the implementation of the Vulcan Centaur Program are anticipated to not impact historic cultural resources. If unanticipated historical discoveries are encountered during construction activities, further evaluation may be required in accordance with 36 CFR Part 800.

4.3.2 No Action Alternative

Under the No Action Alternative, no impact to Historical or Cultural resources would occur.

4.4 Water Resources

This section describes the potential effects to surface water and groundwater, including hydrology, water quality, wetlands and floodplains, resulting from either implementation of the Proposed Action or the No Action Alternative. The FAA has established the following significance thresholds for water resources.

- **Surface Waters** – The action would:
  - Exceed water quality standards established by Federal, State, local, and tribal regulatory agencies; or
  - Contaminate public drinking water supply such that public health may be adversely affected.
- **Groundwater** – The action would:
  - Exceed groundwater quality standards established by Federal, State, local, and tribal regulatory agencies; or

  - Contaminate an aquifer used for public water supply such that public health may be adversely affected.
- **Wetlands** – The action would:
  - Adversely affect a wetland's function to protect the quality or quantity of municipal water supplies, including surface waters and sole source and other aquifers;
  - Substantially alter the hydrology needed to sustain the affected wetland system's values and functions or those of a wetland to which it is connected;
  - Substantially reduce the affected wetland's ability to retain floodwaters or storm runoff, thereby threatening public health, safety or welfare (the term welfare includes cultural, recreational, and scientific resources or property important to the public);
  - Adversely affect the maintenance of natural systems supporting wildlife and fish habitat or economically important timber, food, or fiber resources of the affected or surrounding wetlands;
  - Promote development of secondary activities or services that would cause the circumstances listed above to occur; or
  - Be inconsistent with applicable State wetland strategies.
- **Floodplains** – The action would not cause notable adverse impacts on natural and beneficial floodplain values. Natural and beneficial floodplain values are defined in Paragraph 4.k of DOT Order 5650.2, *Floodplain Management and Protection*.

4.4.1 Proposed Action

4.4.1.1 Surface Water

VSFB Storm Water Management Plan requires BMPs to reduce and eliminate pollutants in stormwater and non-stormwater discharges associated with project activities. All construction and stormwater management would comply with Section 438 of the Energy Independence and Security Act (EISA) (2007), which requires all Federal development that exceeds 5,000 square feet to maintain or restore pre-development hydrology. Low Impact Development standards apply to projects that create 5,000 square feet or more of impervious surface area per Section 438 of the Energy Independence and Security Act of 2007 (EISA). Site design will include Low Impact Development measures to maintain or restore, to the maximum extent technically feasible, the predevelopment flow hydrology of the drainage area or areas. Additionally, the Proposed Action, within SLC-3E, would require coverage under the NPDES General Permit for Construction Activities (Construction General Permit) because the total disturbed area would be greater than 1 acre.

As shown on Figure 4, the total anticipated disturbed area within SLC-3E associated with the Proposed Action is approximately two acres and includes the new LNG access road, LNG equipment area, LH_2 expansion area, LO_2 expansion area and other minor surface impacts. Because the SLC-3E disturbed area is greater than one acre, a NPDES Stormwater Construction Permit would be required and a Stormwater Pollution Prevention Plan (SWPPP) would be implemented. SWPPP execution mitigates impacts from erosion and implements specific measures to control both wind and water erosion of soils during and after construction.

As shown on Figures 5 through 8, the total anticipated disturbed area associated with the roadway modifications, described in Section 2.1.2.2, is less than one acre. Because these areas are isolated and the disturbed area is less than one acre, no NPDES Stormwater Construction Permit would be required; however, a SWPPP and BMPs in accordance with VSFB's Stormwater Management Plan is required.

BMPs will include erosion and sediment controls, tracking controls, material storage, vehicle and equipment fueling and maintenance, spill prevention and control, solid waste management, liquid waste management, concrete waste management, stockpile management and septic waste management. Exposed soils will be permanently stabilized with vegetation or equivalent to prevent erosion and meet the NPDES Construction General Permit Notice of Termination requirements.

Compliance with NPDES stormwater regulations ensures the Proposed Action will not have a significant impact on storm or surface water resources.

Stormwater runoff prior to washdown will be contained to avoid potential for impacts to surface water resources. Stormwater runoff will be tested and treated, if necessary, prior to release.

Under the Proposed Action, launch deluge water would be contained in the existing impermeable concrete retention basin, sampled, and pumped out for disposal. Inadvertent discharge of industrial wastewater (deluge water) into potential jurisdictional waters of the US due to the proximity of a tributary to Bear Creek was reviewed. The existing concrete basin maximum capacity is approximately 267,000-gallons. Vulcan Centaur's combined deluge, sound suppression and washdown water is calculated to be approximately 217,600-gallons; thus, it is highly unlikely that the wastewater would be inadvertently discharged from the basin to surface waters or ground surface. Historical wastewater generation rates from past Atlas V launches have not exceeded 130,000 gallons, and the Atlas V Program has never inadvertently discharged wastewater to surface waters or ground surface. No impacts on surface water are expected to occur from the Proposed Action launch industrial wastewater.

If an early launch abort or failure happens, spacecraft and launch vehicle debris could fall into the ocean and cause potential impacts. Launch vehicle debris from a liquid propellant vehicle is considered a negligible hazard because virtually all hazardous materials are consumed in the destruct action or dispersed in the air and only structural debris would strike the water. In a destruct action, the Vulcan Centaur vehicle may survive to impact the water essentially intact, presenting some potential for localized surface water impact if the spacecraft contains hypergolic propellants that were released into the water. Any resulting pH changes would be very temporary and very localized.

The drainage from SLC-3E could be affected by the exhaust cloud that would form near the launch pad at liftoff as a result of the exhaust plume and evaporation and subsequent condensation of deluge water. Because the Vulcan Centaur booster uses LO_2 and LNG propellants, the exhaust cloud would consist of primarily of steam and would not consist of any significant amounts of hazardous materials. Using larger and more SRMs would result in larger and more frequent HCl ground clouds. Effects on pH of the deluge water from SRM use is known to be small. Any pH changes to surrounding SLC-3E surface waters from the HCl ground cloud is expected to be small and temporary. As the volume of water condensing from the exhaust cloud is expected to be minimal and temporary, the exhaust cloud would generate no significant impacts on surface water quality near SLC-3E.

No significant impacts to surface waters are expected as a result of the Proposed Action.

4.4.1.2 Groundwater

Construction and operational activities have the potential for groundwater quality impacts when pollutants are discharged to the ground. Measures would be implemented during construction and operation to prevent and minimize dispersion pollutants to ground water. During construction, if dewatering is required, authorization through the VSFB IRP would be required to ensure groundwater quality and flow is not impacted. Neither the Proposed Action nor the No Action Alternative use groundwater for any resource, operation or launch purposes.

Liquids, petroleum products and hazardous materials will be stored in a manner that prevents contact with stormwater, i.e., stored in approved containers and drums and placed in proper containment facilities covered prior to rain events. Fueling would be conducted at designated location with appropriate spill prevention and control in accordance with the current VSFB spill response plan and the ULA ICP.

No significant impacts to groundwater are expected as a result of the Proposed Action.

Accumulated stormwater and non-stormwater discharges would be managed in accordance with the VSFB *Discharge to Grade* Program and as authorized by the California Regional Water Quality Control Board, Central Coast Region, General Waiver Resolution No. R3-2019-0089R3. Samples of wastewater would be collected and reported to VSFB under the Discharge to Grade Program. Wastewater produced as a byproduct of launch activities would be collected, sampled and discharged to grade if the water met criteria or hauled to an approved wastewater facility, currently Buttonwillow hazardous waste facility, outside of VSFB. Any operations that would modify the quantity or type of wastewater would require an update to the waiver enrollment.

4.4.1.3 Wetlands and Floodplains

Vulcan Centaur Program modifications to SLC-3E are not expected to disturb wetlands or affect any floodplains within the SLC-3E perimeter. There are no wetlands or floodplains present within the project area. Reference ***Appendix A, Figure 14. Area Wetlands.*** and ***Appendix A, Figure 15. Flood Zone 100 yr.*** for details.

4.4.2 No Action Alternative

Under the No Action Alternative, the Vulcan Centaur Program would not be implemented; thus, no impacts to water resources would occur.

4.5 Hazardous Materials and Solid and Hazardous Waste

This section covers hazardous materials and solid and hazardous waste related to Proposed Action construction and operations and the no action alternative.

4.5.1 Proposed Action

4.5.1.1 Hazardous Materials, Solid and Hazardous Waste

Construction activities require the use of hazardous materials. Hazardous materials expected to be used include diesel fuel, gasoline and propane to fuel the construction equipment; hydraulic fluids, oils, and lubricants; welding gases; paints and solvents; adhesives and batteries. Hazardous materials associated with construction activities would be delivered and stored to prevent leaking, spilling and potentially polluting soils, groundwater, and surface waters, and in accordance with applicable Federal, State, and local environmental and public and occupational health and safety regulations. Public transportation routes would be used for the conveyance of hazardous materials during construction. Transportation of all materials would be conducted in compliance with DOT regulations.

Construction activities will also generate C&D and solid wastes. The construction contractor is required to properly manage and dispose of C&D debris and solid waste in accordance with State and Federal regulations.

Launch operations, routine maintenance and flight support activities would require the use and storage of hazardous materials in quantities described in Section 2.1. Hazardous materials used on the Vulcan Centaur Program would be the same as currently used on the Atlas V Program, with the exception that LNG would be used instead of RP-1. In addition to propellants (LNG, LH_2 and LO_2) and flight batteries, typical operations and maintenance activities would require use of products containing hazardous materials, including paints, solvents, oils, lubricants, acids, batteries, surface coating, and cleaning compounds. These materials would be handled, stored, and disposed of in accordance with the Safety Data Sheet recommendations and storage in accordance with applicable Federal and State regulations would minimize the potential for impacts to the launch pad and surrounding areas. Hazardous materials such as propellants, chemicals and other hazardous material payload components would be transported per DOT regulations (e.g., 49 CFR Parts 100-199) governing interstate and intrastate shipment of hazardous materials, as applicable.

As is current practice, hazardous materials used for maintenance or in-flight preparation would be stored in their original containers with their original product labels and stored on pallets under cover and with secondary containment or in appropriate hazardous material cabinets. Incompatible materials would not be stored together, and sufficient space would be provided between stored containers to allow for spill cleanup and emergency response access. Storage units would meet building and fire code requirements and would be located away from vehicle traffic. Storage instructions would be posted, and construction employees would be trained in proper receiving, handling and storage procedures. Safety Data Sheets for all materials stored on the site would be provided and available to all site personnel.

Facility modifications may require ACM surveys and demolitions notifications. Asbestos disturbance, abatement, notifications and demolition work orders, work clearances, and permits would be reviewed by 30 SW CES/CEIEC prior to agency submission and regulated by 40 CFR Part 61 the National Emission Standards for Hazardous Materials (NESHAP) and the Santa Barbara County Air Pollution Control District (SBCAPCD). Prior to commencement of a renovation or demolition project, the area will be adequately inspected for the potential asbestos containing materials and a SBAPCD Notification for Renovation and Demolition, Form ENF-28

will be obtained. Other regulations associated with facility modifications include CFR Part 1910, 29 CFR Part 1926 and 40 CFR 763 and Cal-OSHA asbestos standards 8 CCR.

With the implementation of appropriate storage, handling and management procedures, hazardous materials used during the Proposed Action construction, operation and maintenance would have no significant impacts on the environment.

4.5.1.2 Hazardous Waste and Hazardous Waste Management

Hazardous waste would be generated during Proposed Action construction activities would be expected to include empty containers, spent solvents, paints, sealants, adhesives, waste oil, spill cleanup materials (if used), lead acid batteries and various universal wastes. Other hazardous materials such as welding gases are expected to be consumed in their entirety and the empty gas cylinders returned to the suppliers. Construction contractors would be responsible for safely removing these construction-generated wastes and for arranging for recycling or disposal in accordance with applicable regulations.

The total monthly generation of hazardous waste during construction is anticipated to be less than 100 kilograms during a calendar month. The construction contractor would be (contractually) responsible for determining their regulatory status regarding hazardous waste generation (during construction and obtaining and maintaining compliance) per Federal and State laws and complying with regulations.

Small quantities of hazardous waste would be generated during routine operations and maintenance. ULA is a small quantity generator with a 180 day satellite site. Most of the hazardous materials would be consumed, so no substantial volumes of hazardous waste would require disposal. Launch vehicle maintenance, propellant and fuel storage and dispensing, and facility and grounds maintenance are among those activities that may generate very small quantities of hazardous wastes. The sources of hazardous waste include waste fuel, waste oils, spent solvents, paint waste, spill response materials, and used batteries.

With the implementation of appropriate handling and management procedures, hazardous wastes generated during the Proposed Action construction, operation and maintenance would have no significant impacts on the environment.

4.5.1.3 Spills

The storage and transport of hazardous materials or waste would have the potential to result in accidental spills that could adversely impact soil, surface water, and groundwater adjacent to transportation routes or down-gradient from the construction or operations areas. Potential impacts to water resources with regards to spills are discussed in Section 4.8, Water Resources. Soils adversely affected by spills would be treated on site or would be removed and disposed of in accordance with applicable Federal and State regulations. Hazardous wastes associated with construction and operations activities would be stored in a manner (per applicable regulations) that would prevent these materials from polluting soils, groundwater and surface waters and in accordance with applicable Federal, State, and local environmental and public and occupational health and safety regulations. During construction, individual contractors would be responsible for the safe and compliant collection, management, and transport of their hazardous wastes to offsite permitted waste disposal facilities.

To minimize the potential for surface water or groundwater contamination, ULA has implemented an existing emergency and spill/release plan, the ICP, to ensure that adequate and appropriate guidance, policies and protocols regarding hazardous material incidents and associated emergency response are available to and followed by all personnel. Emergency response and cleanup procedures contained in the plan would reduce the magnitude and duration of any impacts both on and off site and would be revised to include LNG and address its hazards.

4.5.1.4 Installation Restoration Program

SLC-3E and the proposed roadway improvements are not known to be within existing IRP investigation or restoration areas and therefore, would not be impacted in association with the Vulcan Centaur Program operations.

4.5.1.5 Pollution Prevention

Best Management Practices (BMPs) for pollution prevention would be implemented consistent with the Pollution Prevention Act of 1990. ULA prevents pollution via source reduction whenever feasible. Polluting substances whose use cannot be avoided would be recycled and/or treated per applicable laws. Disposal of all polluting substances would be done under applicable laws. All accidental releases of polluting substance would be responded to quickly and appropriate clean up measures would be implemented per applicable laws to minimize impacts to the environment.

4.5.1.6 Solid Waste Management

The Proposed Action construction and launch operations would generate solid waste, such as C&D, office waste, break room waste, packaging from supplies and launch operations waste that is not hazardous.

C&D solid waste, including concrete and some scrap metal, would be generated during construction. Management of C&D is the responsibility of the construction contractor. Contract documents would require solid waste to be recycled if feasible; or disposed of at an existing, permitted off-site landfill. Construction actions are anticipated to generate minimal amounts of solid waste compared with the capacity of local C&D disposal facilities.

The EPA estimates that one person generates 4.40 pounds of waste per day.[36] Based on an average of 200 fulltime Vulcan Centaur Program employees, we expect that approximately 880 pounds of solid waste would be generated per day, resulting in approximately 114 tons of solid waste generated per year (assuming 260 work days). Solid waste generation based on the number of employees is the same for both the Proposed Action (Vulcan Centaur Program) and No Action (Atlas V Program) alternative.

We expect solid waste generated from Vulcan Centaur launch support activities to be the same as the current Atlas V Program.

4.5.2 No Action Alternative

Under the No Action Alternative, the Vulcan Centaur Program would not be implemented, thus hazardous materials and hazardous and solid waste impacts would not change from the existing Atlas V Program.

4.6 Health and Safety

This section addresses the health and safety effects on people in the impacted area as a result of the Proposed Action or the No Action Alternative.

4.6.1 Proposed Action

4.6.1.1 On-site Safety and Health

The Vulcan Centaur Program would adhere to OSHA regulation 29 CFR Part 1910, *Occupational Safety and Health Standards,* for the protection of personnel health and safety. The Proposed Action entails common safety hazards associated with potential exposure to hazardous materials, heavy equipment operation and construction activities, requiring precautions for workers. All appropriate regulations, including OSHA regulation 29 CFR Part 1926, *Safety and Health Regulations for Construction*, would be followed during project activities to minimize potential impacts. No significant adverse impacts are anticipated to human safety and health.

As described in Section 2.2.3 Safety Systems, safety regulations ensure that the general public, launch area personnel and foreign land masses are provided an acceptable level of safety, and that all aspects of pre-launch and launch operations adhere to public laws. Range Safety organizations review, approve, monitor, and impose safety holds, when necessary, on all pre-launch and launch operations.

Launch facilities used to store, handle, or process ordnance items or propellants must have an Explosive Quantity-Distance Site Plan. A toxic hazard assessment (THA) must also be prepared for each facility that uses toxic propellants. The THA identifies the safety areas to be controlled during the storage, handling and transfer of the toxic propellants.

Hazardous materials such as propellants, ordnance, chemicals, and booster/payload components are transported in accordance with DOT regulations for interstate shipment of hazardous substances (Title 49 CFR Parts 100-199). Hazardous materials such as liquid rocket propellant is transported in specially designed containers to reduce the potential of a mishap should an accident occur.

The Vulcan Centaur Program will adhere to all ULA, USSF, VSFB, State and Federal safety and health regulations and requirements. The Vulcan Centaur Program construction and launch operations will have no significant impacts on on-site personnel health and safety.

4.6.1.2 Launch Vehicle Impacts

VSFB Range Safety models predict launch hazards to the public and on-site personnel prior to every launch. These models calculate the risk of injury resulting from toxic gases, debris, and blast overpressure both from nominal launches and launch failures. Launches are postponed if predicted risk of injury exceeds acceptable limits. The VSFB allowable collective public risk limit is less than or equal to $30x10^{-6}$ with an individual risk of $1x10^{-6}$ over the varying population densities, accounting for concentration, location, dwell time, and emergency preparedness procedures.

Although unlikely, a launch could fail. A launch failure could occur on the launch pad or after the launch vehicle has traveled several miles into the atmosphere. Other scenarios could occur

including the entire launch vehicle, with onboard propellants, being consumed in a destruct action during flight. In this case, the launch vehicle is largely consumed in the destruct action, but residual propellant escapes and vaporizes into an airborne cloud. The April 1998 *Final Environmental Impact Statement Evolved Expendable Launch Vehicle Program* and March 2000 *Final Supplemental Environmental Impact Statement (SEIS) for the EELV Program* document modeling and analysis of the effects of launch failures, including modeling the maximum downwind concentrations of pollutants for launch failures. Failure of the Vulcan Centaur vehicle generally fits within these analyses that concluded all predicted launch failure emissions concentrations are less than the regulatory air emission standards or permissible exposure limit (PEL) for exposure of an employee to a chemical substance.

Catastrophic failure of a payload and the release of hazardous substances due to a launch failure is covered under a separate NEPA action specific to the payload customer. However, the safety and health impacts of on-site failure of a payload that releases hazardous substances are addressed in ULA's Process Safety Management program and documented in the Fuel Payload Process Hazard Analysis.[37]

USSF has existing a rigorous launch safety certification process which would require a launch license from the FAA prior to the start of launch operations. This will ensure that the public will not be exposed to greater risk than the launches currently at approved at VSFB. Thus, the Proposed Action would not have a significant impact to the health and safety of the public.

4.6.2 No Action Alternative

Under the No Action Alternative, the Vulcan Centaur Program would not be implemented, with no change to current impacts on Health and Safety.

4.7 Land Use

Applicable topics include land use, coastal resources, light emissions, and visual resources/visual character. The FAA has not established a significance threshold for these topics.

4.7.1 Proposed Action

The Proposed Action would occur primarily at SLC-3E, which is designated for space launch activities, secondarily at the Solid Motor Building, three existing roadway intersections, and the SLC-3E main entrance. Operations would be consistent with both the Base General Plan and the Space Force mission at VSFB. The Proposed Action would not convert prime agricultural land to other uses; result in a decrease in the land's productivity; or conflict with existing uses or values of the project area or other base properties. The Proposed Action would generate no significant impacts on VSFB land use and launch frequency would remain consistent with the existing ULA launch programs as shown in ***Table 5-1*** and ***Table 5-2***, below.

Activities at SLC-3E, Solid Motor Building and existing roadway intersections would be in conformance with the designated use for space launch activities.

The existing ULA facilities are not visible by the public except from the ocean. Facilities built for Vulcan Centaur will be within the existing Atlas footprint and are all shorter than existing facilities. Therefore, the Proposed Action would generate no significant impacts on visual resources within the flight range of the Vulcan Centaur vehicle.

No adverse impacts to the coastal zone are anticipated as a result of activities associated with the Vulcan Centaur Program at SLC-3E and roadway infrastructure. Coordination with the CCC for Coastal Consistency Determination is required for launch and infrastructure improvements since both activities would occur within the coastal zone. VSFB addressed the Proposed Action with Commission staff and requested CCC concurrence for a Negative Determination. On October 8, 2020, the CCC provided letter response to SLD 30, included as ***Appendix G***, reviewed and agreed that the proposed Vulcan Centaur Program will not adversely affect coastal zone resources.

The proposed Vulcan Centaur Program construction and refurbishment activities are within the existing Atlas V footprint. Outside the SLC-3E perimeter fence, three intersections of roadway will require expansion for rocket component delivery operations. All Vulcan Centaur construction, refurbishment, operations, and launch activities would be coordinated with VSFB. The Proposed Action would have no significant impacts to land use, zoning, natural shoreline processes and coastal resources.

4.7.2 No Action Alternative

Under the No Action Alternative, the Vulcan Centaur Program would not be implemented; thus, no change to visual resources, land use, zoning, natural shoreline processes and coastal resources impacts would occur.

4.8 Noise

The EPA administers the Noise Control Act of 1972, 40 CFR Part 209 and has identified 65 DNL (dBA) or a CDNL of 61 decibels relative to the carrier (dBC) for sonic booms or rocket noise as an acceptable noise level for compatible land uses. This level is not regarded as a noise standard, but as a basis to set appropriate standards that should also factor in local considerations and issues. For project-related overpressures at one psf, the probability of a window breaking ranges from one in a billion to one in a million. In general, the threshold for building damage due to sonic booms is 2 psf,[38] below which damage is unlikely.

Per FAA Order 1050.1F, noise impacts are considered significant if the action would increase noise by DNL 1.5 dB or more for a noise sensitive area that is exposed to noise at or above the DNL 65 dB noise exposure level, or that will be exposed at or above the DNL 65 dB level due to a DNL 1.5 dB or greater increase, when compared to the no action alternative for the same timeframe. For example, an increase from DNL 65.5 dB to 67 dB is considered a significant impact, as is an increase from DNL 63.5 dB to 65 dB.

Noise impacts from the operation of construction equipment are usually limited to a distance of 1,000 feet or less. Vehicles associated with the Proposed Action typically have noise levels between 65 dBA and 100 dBA at a distance of 50 feet.[39]

Temporary noise sources such as refurbishment and demolition would be considered significant if they resulted in noise levels 10 dB or more above the 85 dB, a noise threshold limit value for construction workers in an eight-hour day.

Under 29 CFR Part 1910, protection against the effects of noise exposure would be provided. When employees are subjected to elevated sound levels from construction activities, feasible administrative or engineering controls would be used. If such controls do not reduce sound

levels to the levels presented in ***Table 3-7: Sound Level Descriptors***, hearing protection would be provided and used to reduce exposure.

Noise impact criteria are based on land use compatibility guidelines and on factors related to the duration and magnitude of noise level changes. Annoyance effects are the primary consideration for most noise impact assessments on humans. Noise impacts on wildlife are discussed in Section 4.3.1.1, Construction Impacts, Section 4.3.1.2, Operations Impacts and Section 4.3.1.3, Launch Impacts on Vegetation, Wildlife and Marine Life.

4.8.1 Proposed Action

Noise generated during Proposed Action launch and construction operations includes launch (engine), sonic boom and construction noise.

4.8.1.1 Launch Noise and Sonic Booms

ULA contracted with Blue Ridge Research and Consulting, LLC (BRRC) to develop the technical report *Noise Study for United Launch Alliance's Vulcan Centaur Launch Vehicle Operations at Vandenberg Air Force Base*,[40] to address launch and sonic boom noise. The FAA's Office of Environment and Energy approved the use of BRRC's noise model for the project. The report and FAA approval letter are contained in ***Appendix H*** and the results are summarized in the following sections. BRRC developed and used their Launch Vehicle Acoustic Simulation Model (RUMBLE) noise model to predict the noise associated with the proposed Vulcan Centaur launch operations. Based on BRRC's analysis, noise due to launch and sonic booms was not considered to be a significant impact.

4.8.1.1.1 Launch Noise

A single Vulcan Centaur launch event may generate levels at or above a maximum A-weighted sound level (LA,max) of 115 dBA within 0.7 miles of the launch pad, as shown by the orange contour in ***Appendix A, Figure 9. LA,max for Vulcan Centaur (single core and six SRB's)***. The 115 dBA contour is entirely within the boundaries of VSFB.[41]

Structural damage claims were assessed by analyzing the 111 dB and 120 dB Lmax contours generated by a Vulcan Centaur launch event and shown in ***Appendix A, Figure 10. Lmax for Vulcan Centaur (single core and six SRB's)***. The potential for structural damage claims is approximately one damage claim per 100 households exposed at 120 dB and one in 1,000 households at 111 dB. For launch events, Lmax in excess of 120 dB and 111 dB would be limited to a radius of 4.4 miles and 11.1 miles from the launch pad, respectively. The 120 dB contour is entirely within the boundaries of VSFB, except for agricultural land, west of the City of Lompoc. The area between 111 dB and 120 dB contours includes Lompoc, Mission Hills and Vandenberg Village. The 111 dB contour includes La Purisima Mission State Historic Park.[42]

As shown in BRRC's noise report, the DNL 65 and 60 dBA contours extend approximately 1.15 and 0.70 miles from the launch pad, respectively as shown by the blue contours in ***Appendix A, Figure 11. CNEL for Vulcan Centaur (single core and six SRB's)***. This area does not encompass land outside the boundaries of VSFB, and thus no residences are impacted. Therefore, Vulcan Centaur launches would not result in significant noise impacts.

4.8.1.1.2 Sonic Boom

Sonic booms resulting from the Vulcan Centaur nominal launch trajectory would be directed south-southeast out over the Pacific Ocean in the direction of the launch azimuth, making them inaudible on the mainland. With respect to human annoyance, health and safety, or structural damage; noise impacts due to sonic booms for the launch trajectory are not expected, except for the US Naval Outlying Landing Field on San Nicolas Island, which may experience sonic boom peak overpressures of approximately 0.25 psf as shown in ***Appendix A, Figure 12. Sonic Boom Peak Overpressure Nominal Vulcan Centaur***. Historically, a sonic boom due to the overflight of a Titan IV from Vandenberg SFB was measured at a number of locations in the Channel Islands, 30 to 40 miles from the launch pad. The over pressures recorded at these locations were less than 2.4 psf, with the exception of one site which recorded an 8.4 psf focused sonic boom. Heavy-class vehicles have been launched from VSFB, so the community is familiar with the sonic boom impacts.[43]

The maximum focus overpressures are in the four to eight-psf range. This is comparable to the focus boom overpressures routinely generated by military aircraft during supersonic training missions over both land and water,[44] and similar to focus boom overpressures generated by other launch vehicles. Since the entire boom footprint is over water, the only potential impacts would be to wildlife, refer to Section 4.3 Biological Resources. However, no current or past launch programs on VSFB have been documented as causing any animal mortality or significant impact to wildlife habitat on VSFB.

Underwater penetration of the sonic boom was analyzed in the 2000 SEIS as cited below:

> *A significant feature of sonic booms penetration underwater, which is shared by all launches considered by the Proposed Action* [Atlas V]*, is that high overpressures compared to those on the sea surface would be found mainly within the first 60 feet below the surface, and would be the result of the focus and edge booms. Below this level, the carpet boom wave field would become more important. Overpressure magnitudes attenuate rapidly with increasing depth, reducing to 0.3 psf or less at the 400-foot depth. Similar results would occur for an Atlas V 551/552 for the LEO launches.* (2003 FEA)

The Proposed Action would fit within the bounds of that analysis and its conclusion that no significant impacts are expected to occur from the underwater penetration of sonic booms.[45]

4.8.1.2 Construction and Refurbishment Impacts

A temporary increase in ambient noise levels would occur at SLC-3E and the surrounding area during the construction of the LNG System and modification to the ASWS, LH_2 and LO_2 systems due to the operation of any heavy equipment (e.g., earth moving machinery, dump trucks). Noise impacts from the operation of construction equipment are usually limited to a distance of 1,000 feet or less. No residential areas or other sensitive receptors occur at, or near, SLC-3E; therefore, refurbishment noise would not impact the public or sensitive receptors.

When employees are subject to sound exceeding those listed, engineering or administrative controls would be used and/or personal protective equipment such as approved ear plugs would be provided. Therefore, noise effects on construction workers would have no significant impact under the Proposed Action. Noise level impact on workers would be regulated by complying with OSHA requirements to limit noise impacts on workers and OSHA standards would be

followed to protect worker safety related to noise levels. Monitoring of worker exposure to noise would be conducted as required by OSHA.

4.8.1.3 Airspace Closures

Airspace closures associated with launches could result in temporarily grounded aircraft at affected airports and re-routing of en-route flights on established alternate flight paths. The FAA has rarely, if ever, received reportable departure delays associated with launches. Aircraft could be temporarily grounded if airspace above or around the airport is closed. Ground delays are also used under some circumstances to avoid airborne reroutes. If aircraft were grounded, noise levels at the airport could temporarily increase as the planes sit idle. Also, depending on the altitude at which aircraft approach an airport, there could be temporarily increases in noise levels in communities around the airports. However, aircraft would travel on existing en-routes and flight paths that are used on a daily basis to account for weather and other temporary restrictions. Re-routing associated with launch-related closures represents a small fraction of the total amount of re-routing that occurs from all other reasons in any given year. Any incremental increases in noise levels at individual airports would only last the duration of the airspace closure on a periodic basis and are not expected to meaningfully change existing day-night average sound levels at the affected airports and surrounding areas. Therefore, airspace closures due to launches are not expected to result in significant noise impacts. Advancements in airspace management are expected to further reduce the number of aircraft that would contribute to noise at the affected airports and surrounding areas.

4.8.2 No Action Alternative

Under the No Action Alternative, no construction or refurbishment noise would occur. Operational noise and sonic booms would remain the same as the current Atlas Program.

4.9 Environmental Justice

A significant impact to environmental justice would occur if:

- A significant adverse impact occurs to the natural or physical environment or to health that affected a minority or low-income population;
- A significant adverse environmental impact occurs on minority or low-income populations that appreciably exceeded those on the general population or other comparison group;
- The risk or rate of environmental hazard exposure by a minority or low-income population was significant and exceeded those by the general population or other comparison group; or
- A health or environmental effect occurred in a minority or low-income population affected by cumulative or multiple adverse exposures from environmental hazards.

The FAA has not established a significance threshold for environmental justice.

4.9.1 Proposed Action

The construction of Vulcan Centaur Program facilities, and the operation and launch of Vulcan Centaur will occur in the same area as the existing Atlas V Program. The area is not located adjacent to or near minority populations or low-income population centers. Lompoc and Santa Maria Valleys are the closest populated area to the Proposed Action activities. The proposed construction activities would not produce excessive pollution or create a hazardous situation that would impact the surrounding community, regardless of economic background. The Proposed Action would not substantially affect human health or the environment and would not disproportionately affect any population group, including minority or low-income populations. The proposed action would not have significant impacts on Environmental Justice.

4.9.2 No Action Alternative

Under the No Action Alternative, the Vulcan Centaur Program would not be implemented, thus, no change to Environmental Justice would occur.

4.10 Orbital and De-Orbiting Debris

Because orbital debris may re-enter the Earth's atmosphere, NASA's policy is to employ design and operations practices that limit the generation of orbital debris, consistent with mission requirements and cost-effectiveness. NASA Safety Standard (NSS) 1740.14 "Guidelines and Assessment Procedures for Limiting Orbital Debris" requires conducting a formal assessment of the potential to generate orbital debris.

Vulcan Centaur Program payloads would comply with all requirements of NPD 8710.3, NASA *Policy for Limiting Orbital Debris Generation*, US Government Orbital Debris Mitigation Standard Practices (USGODMSP), DoDI 3100.12, *Space Policy* and NASA-STD 8719.14A, *Process for Limiting Orbital Debris*. Preparing debris assessments as required by this policy is the responsibility of the payload customers and not ULA.

Environmental and safety impacts resulting from the normal and errant burnout of launch vehicle stages would be controlled at VSFB per USSF COMMAND MANUAL 91-710. That document requires that a trajectory analysis predict the instantaneous surface impact point (IIP) at any moment during launch for either normal flight or debris from a flight terminated by range safety action. This IIP would be overlaid on range maps indicating populated or environmentally sensitive areas, and a launch corridor would be developed. This package of data, called the PFDP is developed for each mission (launch) well in advance of the launch activity. During the actual launch of the Vulcan Centaur vehicle, tracking data and IIP plots would be monitored to assure the launch trajectory stays within the corridor. If a flight approaches corridor limits, it would be destroyed by Range Safety. This assures that spent stages or debris would only impact broad ocean areas cleared of shipping or air traffic.

4.10.1 Proposed Action

This SEA compared the anticipated Vulcan Centaur orbiting and deorbiting debris impacts to the current Atlas V orbital and reentry debris impacts as documented in the November 2011 *Environmental Assessment for Launch of NASA Routine Payload.*[46] The analysis determined that the anticipated Vulcan Centaur orbiting and deorbiting debris impacts are within the scope of the

2011 NASA Routine Payload EA and are therefore categorically excluded from this NEPA evaluation. If future, unanalyzed payloads or launch vehicle configurations pose potential environmental consequences, separate NEPA evaluation(s) will be performed for each unique payload program or launch vehicle configuration, as required.

For all Vulcan Centaur Program missions, the Centaur upper stage would be placed in a disposal orbit. Disposal orbits are orbits that, as a result of current and projected missions and technologies, are effectively useless except as regions of the space environment where spent hardware can be disposed of without impacting current or projected space systems. The Vulcan Centaur upper stage would also be vented to preclude debris creation resulting from explosive overpressure. These techniques are per the LSA/EELV program System Performance Document and international agreements on space debris minimization.[47]

Although the Vulcan Centaur upper stage is larger than the current Atlas V Centaur upper stage, the environmental impact of orbiting and de-orbiting debris is similar. Implementation of the Proposed Action would not likely change the total number of worldwide space launches. Thus, no significant global effect on orbital/deorbiting debris would be incurred from the implementation of the Proposed Action.

4.10.2 No Action Alternative

Under the No Action Alternative, the Vulcan Centaur Program would not be implemented; thus, orbital debris impacts would not change from the existing Atlas V Program.

4.11 Geology and Soils

This section addresses any potential geologic impact of the Proposed Action to foundation instability, land subsidence or other geologic aspects.

4.11.1 Proposed Action

No unique geologic features of exceptional interest or mineral resources occur in the project area; thus, no impacts would occur to these resources. Proposed Action construction would impact soils at or near SLC-3E. The development and implementation of a SWPPP per the NPDES Construction Stormwater permit would specify methods to control erosion. Thus, no significant impacts to geology or soils would occur.

4.11.2 No Action Alternative

Under the No Action Alternative, the Vulcan Centaur Program would not be implemented; thus, no impacts to geology or soils would occur.

4.12 Transportation

This analysis covers the projected transportation and traffic conditions affected by the construction, operation and launch Proposed Action activities.

4.12.1 Proposed Action

4.12.1.1 Construction Impacts

During the Proposed Action construction activities, 200 people, on average, would be working at Vulcan Centaur Program facilities including SLC-3E. Eighty of the 200 people would be directly involved in the project construction. Construction of Vulcan Centaur Program facilities would be conducted in parallel with Atlas V launch preparations. During Atlas V launch windows, construction efforts would be suspended until success launch and post launch safing of SLC-3E is complete. The current construction schedule is approximately 36 months. Assuming the worst-case scenario, an addition of 80 people (or 80 daily vehicle trips) traveling on key roadways within VSFB would not constitute a significant increase in the traffic volume. Construction vehicles would generally be stored and maintained on-site during construction activities. Dump trucks, cranes, and large transportation vehicles would occasionally travel to and from the SLC-3E via the VSFB roadways, however, the increase in construction vehicle traffic would not significantly accelerate the normal wear and tear of the roadways on VSFB. Proposed Action construction would not have a significant impact on transportation assets.

4.12.1.2 Operation Impacts

Vulcan Centaur vehicle components are manufactured at ULA's facility in Decatur, AL, including installation and safing of 1.1 and 1.4 ordnance. Vulcan Centaur vehicle components would be shipped aboard the Rocketship cargo ship from the east coast and received at the VSFB Wharf. The boosters would be transferred from the VSFB harbor onto trucks that travel over VSFB roads to the HIF at SLC-6. The transportation routes used for Vulcan Centaur vehicle components are identical to the current Atlas V routes from the harbor; however, Atlas V also had booster air-transport capabilities, which will not be used for the Vulcan Centaur Program. The weight of Vulcan Centaur components is increased compared to Atlas V, but still meet standard DOT requirements for axle loading. Proposed Action vehicle component transportation would not have a significant impact on transportation assets, and no additional dredging activities are anticipated.

Transportation of payload fairing (PLF) would use the same roads as Atlas V payloads currently use. These routes are illustrated in ***Appendix A, Figure 2. Vicinity Map.***

Approximately 200 people are currently supporting Atlas V launches and this number will not be increased to support the Vulcan Centaur Program. Vulcan Centaur Program operation would require expansion of roadways and intersections to provide adequate maneuverability for rocket component transportation. This expansion should have minimal impact on VSFB and no impact on local or regional traffic patterns or transportation assets.

4.12.1.3 Launch Impacts

The Proposed Action does not include altering the dimensions (shape and altitude) of the airspace issued by the FAA's Air Traffic Organization are Federal actions connected to the Proposed Action and thus analyzed in this SEA. However, temporary closures of existing airspace and navigable waters would be necessary to ensure public safety during launch operations. Advance notice via NOTAMs would assist pilots in scheduling around any temporary disruption of flight activities in the area of operation. Launches would be of short

duration and scheduled in advance to minimize interruption to airspace. For these reasons, significant environmental impacts of the temporary closures of airspace, and the issuance of NOTAMS under the Proposed Action, are not anticipated.

4.12.1.4 Launch Viewing Related Traffic Impacts

Traffic volume increases for a Vulcan Centaur Program launch is expected to be similar to recent Atlas, Delta, SpaceX or Firefly launches. Thus, impacts from increase visitor or public observers would cause no significant impacts on VSFB and local traffic patterns.

4.12.2 No Action Alternative

Under the No Action Alternative, the Vulcan Centaur Program would not be implemented; therefore, no impacts to roadways or transportation routes would occur.

4.13 Utilities

This section describes the potential impacts on the potable water supply, wastewater (industrial and sanitary sewer), electrical supply and stormwater by implementing the Proposed Action or No Action Alternatives. The FAA has not established a significance threshold for energy supply.

4.13.1 Proposed Action

4.13.1.1 Water Supply

Current potable and non-potable water supply to SLC-3E was designed to support the Atlas V launch vehicle program and is adequate to support the Vulcan Centaur Program. Vulcan Centaur Program non-potable water needs are greater than the current Atlas V needs because the larger vehicle requires approximately 7,600 gallons (3.6%) of additional sound suppression and washdown water per launch. ***Table 4-6: Water Requirement Estimates per Launch*** contains the water requirements for both Atlas V and Vulcan Centaur launches. Washdowns of equipment and facilities occur only when SRM are used on launch vehicle configurations.

Table 4-6: Water Requirement Estimates per Launch

Operation	Atlas V (gal)	Vulcan Centaur (gal)
Deluge/Sound Suppression	172,000	179,600
Washdown (SRM configurations only)	38,000	38,000
Total per Launch (assuming SRM configuration)	**210,000**	**217,600**

Table 2-1: Planned and Projected ULA Vehicle Launches at VSFB contains the proposed launch rates for Vulcan Centaur launches. As noted in the table, launch projections greater than two years out are subjective. The peak yearly rate of six Vulcan Centaur launches would require approximately 1.3 million gallons of water.

The Proposed Action water requirements are well within the design availability and capacity would generate no significant impacts on water supply.

4.13.1.2 Wastewater

The Vulcan Centaur Program does not anticipate adding personnel, so domestic wastewater generation is anticipated to remain the same as the Atlas V Program's generation. Construction personnel do not add appreciably to the sanitary sewer load as the contractor is required to provide on-site sanitary facilities.

Deluge and sound suppression industrial wastewater generation will increase by less than 7,600-gallons per launch due to vaporization during launch. Assuming approximately half of the deluge and sound suppression water is vaporized at launch, at the peak yearly rate of 6 launches per year, the Vulcan Centaur Program will generate approximately 650,000 gallons of industrial wastewater including washdown water when SRMs are used. Wastewater will be collected in a concrete containment basin, located on the southwest corner of SLC-3E. As stated above the deluge and sound suppression water would be managed in accordance with the VSFB *Discharge to Grade* Program and as authorized by the California Regional Water Quality Control Board, Central Coast Region, General Waiver Resolution No. R3-2019-0089R3. Samples of wastewater would be collected and reported to VSFB under the Discharge to Grade Program. Wastewater produced as a byproduct of launch activities would be collected, sampled and discharged to grade if the water met criteria or hauled to an approved wastewater facility, currently Buttonwillow hazardous waste facility, outside of VSFB.

The Proposed Action would have no significant impacts on the VSFB sanitary sewer or wastewater treatment plant (WWTP) capacity.

4.13.1.3 Electric Power

The Vulcan Centaur Program power requirements are similar to the Atlas V Program and no additional electrical power supply needs have been defined. The Proposed Action would have no significant impact on available electrical power supply.

4.13.1.4 Stormwater

Within the VSFB boundary, outside the VSFB cantonment/urban areas, Low Impact Development standards apply to projects that create 5,000 square feet or more of impervious surface area per Section 438 of the Energy Independence and Security Act of 2007 (EISA). Site design will include Low Impact Development measures to maintain or restore, to the maximum extent technically feasible, the predevelopment flow hydrology of the drainage area or areas.

The Proposed Action minimizes clearing requirements by reusing existing ground support equipment to the greatest extend feasible. New impervious area within the SLC-3E is anticipated to be less than two acres and maintains existing site drainage patterns and controlled discharge (see Figure 4).

4.13.2 No Action Alternative

Under the No Action Alternative, the Vulcan Centaur Program would not be implemented, with no impact to current utility services.

4.14 Department of Transportation Act Section 4(f) Properties

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

4.14.1 Proposed Action

Vulcan Centaur launches would close public access temporarily to Surf Beach, Ocean Beach, and Jalama Beach County Parks, because these beaches and parks fall within the launch hazard area. Although the beaches and parks would not be directly over flown by Vulcan Centaur, a launch anomaly could impact them. Therefore, for public safety reasons, the County Parks Department and the County Sheriff close public access upon request from SLD 30. Since 1979, an evacuation and closure agreement had been in place between USSF and Santa Barbara County. The agreement recently expired, and the parties are in the process of renewing it. Historically, the agreement includes closing public access to Surf Beach, Ocean Beach, and Jalama Beach County Parks during launches. The USSF sends an evacuation notice to the listed county parks at least 72 hours prior to the closure, and the closure is not to exceed 48 hours. The notice will state a hazardous operation will occur. Under the Proposed Action, closure of the beaches and parks would have the potential to occur up to three times per year. The closure would only last as long as necessary to assure the public is safe during a launch (approximately six to eight hours).

Surf Beach and County of Santa Barbara Ocean Beach Park are outside the 100 A-weighted decibels (dBA) contour during the Vulcan Centaur launch activities as shown on Figure 9. The other Section 4(f) properties would experience sound at lower levels during launches. According to the BRRC Report (***Appendix H***,) "the focus boom region begins downrange of the northern Channel Islands of San Miguel, Santa Rosa, Santa Cruz, and Anacapa. Thus, these islands are not predicted to experience sonic booms. Low-level sonic booms of approximately 0.25 psf, comparable to distant thunder, may be experienced on parts of San Nicolas Island". Reference Figure 12. Both launch noise and sonic booms are classified as short-duration events. Given the small area of potential impact over the Channel Islands, and the short-duration of the event, impacts as a result of the sonic boom overpressure would not result in significant impacts to the Channel Islands National Park.

Given the history of beach and park closures for launches at VSFB, the formal evacuation agreement in place, and the temporary nature of the closures, the FAA has made a preliminary determination the Proposed Action would not substantially diminish the protected activities, features, or attributes of any of the potential Section 4(f) properties, and therefore the Proposed Action would not result in a constructive use of any Section 4(f) property. Therefore, the FAA's proposed action of issuing ULA a license would not result in significant DOT Act Section 4(f) impacts. The FAA will make a final determination based on any input received from the public during the comment period for the draft SEA.

4.14.2 No Action Alternative

Under the No Action Alternative, the Vulcan Centaur Program would not be implemented, thus, no change to Section 4(f) properties would occur.

4.15 Socioeconomics

Socioeconomics impacts would be considered significant if they substantially alter the location and distribution of the local population, economic growth rates, the local housing market and the need for new social services and support facilities. The FAA has not established a significance threshold for socioeconomics.

4.15.1 Proposed Action

Preparations for Atlas V launches and launch day activities last from two to eight weeks. For approximately one week during this time, a peak of 200 people, not including payload support personnel, support the launch at SLC-3E and other Atlas V support facilities. Between launch campaigns, fifty to sixty employees are present at the site. The Vulcan Centaur launch preparation timeframe and personnel requirements are anticipated to be similar to Atlas V requirements. Thus, the Vulcan Centaur Program will not impact population or growth rate of the region. The Proposed Action would not affect the local housing market or the need for new social services or support facilities. The Proposed Action would generate no negative socioeconomic impacts on the region.

Construction and refurbishment activities for the Proposed Action would result in a temporary and minor increase in the number of personnel on VSFB. This increase would not represent a significant increase in the population or growth rate of the region, since most construction personnel already live and work in the area. The local housing market would not be substantially affected, and no new social services or support facilities would be required. Construction and refurbishment activities of the Proposed Action would generate no negative socioeconomic impacts on the region.

Purely social and economic effects are not required to be analyzed under NEPA. Even if NEPA recognizes socioeconomic impacts from re-routing aircraft due to launches, such impacts would be similar to re-routing aircraft for other reasons (e.g., weather issues, runway closures, wildfires, military exercises, and presidential flights). Potential socioeconomic impacts include additional airline operating costs for increased flight distances and times resulting from re-routing aircraft and increased passenger costs as a result of impacted passenger travel, including time lost from delayed flights, flight cancelations, and missed connections. Alternatively,

restricting or preventing a launch event would have socioeconomic impacts on ULA, commercial payload providers, and consumers of payload services. Operations would not result in the closure of any public airport during the operation nor so severely restrict the use of the surrounding airspace as to prevent access to an airport for an extended period of time. A maximum of six launches per year are projected and the estimated airspace closure time is six to eight hours for each launch. Given existing airspace closures for launches are temporary and the FAA's previous analyses related to the National Airspace System (NAS) have concluded minor or minimal impacts on the NAS from launches, the FAA does not expect airspace closures from ULA's proposal would result in significant socioeconomic impacts. Furthermore, local air traffic controls would coordinate with airports and aircraft operators to minimize the effect of the launch operations on airport traffic flows as well as traffic flows in enroute airspace.

4.15.2 No Action Alternative

Under the No Action Alternative, the Vulcan Centaur Program would not be implemented, with no impacts on socioeconomics.

4.16 Summary of Potential Environmental Effects

Table 4-7: Summary of Potential Environmental Impacts from the Proposed Action and the No Action Alternative summarizes the potential environmental effects in the 15 categories for the Proposed Action and No Action Alternative.

Table 4-7: Summary of Potential Environmental Impacts from the Proposed Action and the No Action Alternative

Aspect Area	Proposed Action Environmental Impacts	No Action Alternative
Land Use Zoning/ Visual Resources	Launches would not result in significant impacts to land use compatibility at VSFB. SLC-3 is designated for space launch activities consistent with the VSFB General Plan. The Proposed Action would not impact or require changes to land use. Facilities built for Vulcan Centaur will be within the existing Atlas V footprint with minor modifications to existing VSFB roadway infrastructure. The Proposed Action has no change to coastal zone impacts. The Proposed Action would generate no significant impacts on visual resources.	No change to existing Atlas V land use or visual resource impacts.

Aspect Area	Proposed Action Environmental Impacts	No Action Alternative
Noise	Construction: Noise impacts from the operation of construction equipment are usually limited to a distance of 1,000 feet or less. No residential areas or other sensitive receptors occur at or near SLC-3E; refurbishment noise would not impact the public or sensitive receptors. When employees are subject to sound exceeding those listed, engineering or administrative controls would be used and/or personal protective equipment such as approved ear plugs would be provided. Noise impacts on construction workers would have no significant effect under the Proposed Action. Operations and Launch: Based on modeled launch noise levels, noise impacts would not be significant based on the DNL 65 dB noise contour for the Proposed Action. Operations and launch noise would not exceed the 85 dBA noise threshold limit value recommended for workers in an 8-hour day. The sonic booms modeled for Vulcan Centaur would intercept the surface more than 40 miles off the coast over Pacific Ocean with a maximum sonic boom overpressure of 10.4 psf and would not be heard on land, except for nominal impacts on the Channel Islands. No significant impacts from launch effect noise including sonic booms is anticipated.	No change to existing Atlas V noise impacts.
Biological Resources	To comply with the requirements of the Endangered Species Act and the Marine Mammal Protection Act and avoid significant adverse impacts to species, ULA would be required to continue to adhere to all requirements of the past consultations with the USFWS and NMFS. With these measures, the Proposed Action may impact vegetation surrounding SLC-3E including a Federally and State of California listed endangered plant, the Gaviota tarplant (*Deinandra increscens ssp. villosa*), which will require monitoring for acid deposition after the first two Vulcan Centaur launch events. Additionally, the Proposed Action may impact wildlife within SLC-3E including Federally threatened and California species of concern, the California Red-Legged Frog (*Rana draytonii*), which will require pre- and post-launch pH monitoring during the first two Vulcan Centaur launch events. Overall impacts on Biological Resources are anticipated to be insignificant and comparable to the current Atlas V Program.	No change to existing Atlas V biological resource impacts.
Historical and Cultural Resources	SLD 30 Cultural Resources Manager evaluated the Proposed Action affected areas and no historical or cultural resource issues were found within the boundaries of SLC-3E or the proposed roadway improvements. The Proposed Action would have no effect on Historical or Cultural Resources. The California Department of Parks and Recreation Office of Historic Preservation State Historical Resources Commission concurred with the USSF's findings that no historic properties will be affected by the Proposed Action. The Santa Ynez Band of Chumash Indians, concurred in writing "that the effort to identify cultural resources within the action areas is satisfactory."	No impacts on cultural resources would occur.

Aspect Area	Proposed Action Environmental Impacts	No Action Alternative
Air Quality	Construction: Air emissions from construction activities) would cause a minor increase in PM emissions due to demolition, excavations, construction vehicles and diesel generators. Carbon dioxide would be released by fossil fuel powered equipment and vehicles. Diesel-powered equipment would emit CO, hydrocarbons, NOx and CO_2. Emissions are expected to be minor from these sources over the expected 36 months of construction. Construction activities are not expected to significantly change regional (Santa Barbara County) or local (VSFB) air emissions. Operations and Launch**:** ULA operations at SLC-3E are not a major source of air pollutants but manage local air construction and operation permits through the SBCAPCD. A new air construction and operations permit is required for the new LNG flare stack support the Vulcan Centaur Program, and the existing RP-1 air permit (09846-R8) will be terminated at the end of Atlas V operations. As documented in previous EA and EISs performed for the launch vehicles at VSFB, emissions from nominal launches, catastrophic launch failures, or spills of liquid propellants would not substantially impact ambient air quality. Proposed Action air emissions from include PM, VOC, NOx, SOx and CO_2/CO. Air emissions from Vulcan Centaur launches with SRMs are expected to be similar to Atlas V or Delta IV launches with SRMs with minor increases to total VSFB emissions. LNG is a cleaner burning fuel than RP-1, with anticipated reductions in PM, but overall Vulcan Centaur launch emissions are expected to be similar to the current Atlas V launch emissions. Vulcan Centaur operations at VSFB would not be expected to have a significant impact on air quality.	No change to existing Atlas V air quality impacts would occur.
Climate	Emissions of GHGs from the construction, operations and launch of the Proposed Action alone would not cause any appreciable global warming that may lead to climate change. At present, no methodology exists that would enable estimating the specific impacts that this increment of warning would produce locally or globally. The impact to the climate would still not be significant. The Proposed Action GHG emissions would be essentially unmeasurable and not have a climate change impact.	No change to Atlas V climate impacts would occur.
Orbital and De-Orbiting Debris	The environmental consequences of orbiting and deorbiting debris from additional payloads potentially launched on Vulcan Centaur Program vehicles would be addressed under separate NEPA documentation for each of the satellite programs, as required. Although the Vulcan Centaur upper stage is larger than the current Atlas V Centaur upper stage, the environmental impact of orbiting and deorbiting debris is similar. Implementation of the Proposed Action would not likely change the total number of worldwide space launches. Thus, no significant global effect on orbital/deorbiting debris would be incurred from the implementation of the Proposed Action.	No change to Atlas V orbital debris impacts would occur.
Hazardous Materials/Solid and Hazardous Waste	Construction: The construction of the pad area would result in a small increase in overall hazardous material use and solid waste and hazardous wastes generated but would have no significant impacts on the environment. Operations and Launch: Launch operations, routine maintenance and flight support activities would require the use and storage of hazardous materials and generation of solid and hazardous waste similar in nature and quantities used and generated by the Atlas V Program. No significant impact on hazardous material use or solid or hazardous waste generated is anticipated.	No change to Atlas V hazardous material or solid/hazardous waste impacts would occur.

Aspect Area	Proposed Action Environmental Impacts	No Action Alternative
Water Resources	The Proposed Action would have no significant impact on surface water, groundwater and floodplains and wetlands. Stormwater runoff prior to washdown will be contained to avoid potential from impacts to surface water resources. Stormwater runoff will be tested prior to release to grade. The Proposed Action slightly increases deluge and sound suppression water quantities, but since the existing concrete containment basin has sufficient capacity, and ULA has never inadvertently discharged wastewater, no impacts on surface water are expected. In the event of a launch abort or failure, debris could land in the ocean or other surface waters. Impacts to surface waters from a launch anomaly are similar to current Atlas V launches. Increased SRM use could decrease exhaust cloud pH slightly but it is not expected to significantly impact surface water. ULA's safety and operating procedures minimize the risk of groundwater contamination by fuels or other hazardous liquids. Impacts to water resources would be similar to the current Atlas V and no significant water resource impacts are expected to result from the Proposed Action. A NPDES Stormwater Construction Permit is required since more than one acre will be disturbed on SLC-3E during construction.	No change to Atlas V impacts on water resources would occur.
Geology and Soils	No unique geologic features of exceptional interest or mineral resources occur in the project area; therefore, no impacts would occur to these resources. The Proposed action would have no direct impacts on geology or soils.	No geology or soil impacts would occur.
Transportation	A slight increase in the traffic during the approximate 36 month period of construction is anticipated but it would not significantly impact VSFB roadways. Transportation of Vulcan Centaur components to assembly areas is on a route identical to Atlas V and will require the expansion of existing VSFB transportation routes. During launches, the increase in traffic should be similar to existing launches and would not be significant. No significant transportation impacts are expected to result from the Proposed Action.	No change to Atlas V transportation impacts.
Utilities	Construction and /or refurbishment personnel do not add appreciably to utility loads. Proposed Action impacts on potable water, wastewater and electrical power needs have no significant impacts compared to existing availability and capacity.	No change to Atlas V utility impacts.
Health and Safety	ULA requires all contractors to follow all USSF and Occupational Safety and Health Administration (OSHA) regulations during construction activities with no significant impacts to health and safety of workers. The Vulcan Centaur Program will adhere to all ULA, USSF, VSFB, state and federal safety and health regulations and requirements, as does Atlas V currently. The Vulcan Centaur Program construction and launch operations will have no significant impacts on on-site personnel health and safety.	No change to Atlas V health and safety impacts.

Aspect Area	Proposed Action Environmental Impacts	No Action Alternative
Socioeconomics	The Vulcan Centaur launch preparation timeframe and personnel requirements are anticipated to be similar to Atlas V requirements and will not impact population or growth rate of the region. Construction and refurbishment activities for the Proposed Action would result in a temporary and minor increase in the number of personnel on VSFB. This increase would not represent a significant increase in the population or growth rate of the region, since most construction personnel already live and work in the area. The Proposed Action would generate no negative socioeconomic impacts on the region.	No changes to Atlas V socioeconomic impacts would occur.
Environmental Justice	Environmental impacts generated by construction, refurbishment, operations or launch activities for the Proposed Action would have no significant impacts and would not affect minority or low-income populations or children and would not cause any environmental justice impacts. Use of the SLC-3E site would also not have an impact on any Environmental Justice subject groups.	No impacts to minority or low-income populations would occur.
Section 4(f) Properties	Construction: Proposed Action would not substantially diminish the protected activities, features or attributes of any of the Section 4(f) properties identified. No designated 4(f) properties, including public parks, recreation areas, or wildlife refuges, exist within the boundaries of VSFB. Temporary closures for local recreation areas will be issued, consistent with current VSFB Operations and Launch: Section 4(f) properties are impacted by noise levels from existing Atlas V and other VSFB launches. The Proposed Action would generate no negative Section 4(f) publicly-owned land impacts on the region.	No changes to Atlas V impacts would occur to publicly-owned land.

5 Cumulative Impacts

According to 40 CFR § 1508.7, cumulative impacts are defined as "…the incremental impact of the actions when added to other past, present, and reasonably foreseeable future actions, regardless of what agency (Federal or non-Federal) or person undertakes such other actions. Cumulative impacts can result from individually minor but collectively significant actions taking place over a period of time." Cumulative impacts include impacts from construction and operation of the Vulcan Centaur vehicle that will be launched from SLC-3E, VSFB and other past, present and reasonably foreseeable future activities that could affect the resources impacted by the Proposed Action. Due to the nature of the Proposed Action and its location on the coast within VSFB, only launch-related actions occurring at VSFB would meaningfully interact in time and space with the Proposed Action such that potential cumulative impacts could result.

5.1 Reasonably Foreseeable Future Actions

The new VSFB General Plan states that future development would be guided by sustainability. To accomplish this, 50-year Long Term Development Plans (LTDP) were created for each installation. The LTDP are SLD 30's vision for future development. SLD 30 strategic plans illustrate how increases in launch tempo and associated support activities can occur sustainably and compatibly with the efficient use of land and energy, the conservation of natural resources and the safe operation of launch vehicles and processing facilities.

The past, present, and reasonably foreseeable launch actions at VSFB are listed in ***Table 5-1*** *and* ***Table 5-2*** are assumed to still be accurate and applicable to the Cumulative Impacts analysis in this EA. The launch rate since 2012 is shown below in ***Table 5-1: Past Vehicle Launches at VSFB***.

Table 5-1: Past Vehicle Launches at VSFB

Year	Launch Vehicles (Number of Launches)					Total
	Delta II	Delta IV	Atlas V	Falcon 9	Minotaur-C	
2012	-	1	1	-	-	2
2013	-	1	2	1	-	4
2014	1	-	3	-	-	4
2015	1	-	1	-	-	2
2016	-	1	1	2	-	4
2017	1	-	2	5	1	9
2018	1	1	1	6	-	9
2019	-	2	-	2	-	4
Total Launches	4	6	11	16	1	38

The forecast for VSFB launches during the next several years is presented in ***Table 5-2: Future Planned and Projected Vehicle Launches VSFB***.

Table 5-2: Future Planned and Projected Vehicle Launches VSFB

Year	Launch Vehicles (Number of Launches)					Total
	Delta IV	Vulcan Centaur	Atlas V	Falcon 9	Firefly Alpha	
2020	-	-	-	1	-	1
2021	1	-	1	4	1	7
2022	1	-	1	1	-	2
2023	-	1	-	-	-	-
Total Launches	2	1	2	11	1	16
Notes: Launch rates are approximate only. SpaceX future mission launch manifest shows 11 planned Falcon 9 or Falcon Heavy flights but does not provide timing.						

Documents reviewed for reasonable foreseen actions include:

- EIS EELV Program, April 1998
- Supplemental EIS for the EELV Program, March 2000

5.2 Cumulative Impact Analysis on Resource Areas

The launch actions listed in ***Table 5-1*** and ***Table 5-2***, as well as the projects described above, are considered in conjunction with the Proposed Action and form the basis for the cumulative impacts analysis. This section analyzes the incremental interaction that the Proposed Action may have with the actions described in Section 5.1, Reasonably Foreseeable Future Actions, and evaluates the potential cumulative impacts resulting from these interactions. Except for air quality and noise, the ROI for each resource area discussed below is limited to VSFB. The ROIs for air quality and noise extend beyond VSFB boundaries. As described in the Section 4, no direct impacts were identified on Historical and Cultural Resources, Geology and Soils, Health and Safety, Environmental Justice and Section 4(f) Properties. When considered with other past, present, and foreseeable future actions, the Proposed Action would not contribute to any cumulative impacts associated with these resource categories and they are not considered further in this analysis.

5.2.1 Land Use

The proposed action would not result in any additional impacts to land use compatibility since VSFB and SLC-3E current use includes launching space vehicles. The Proposed Action would not generate additional impacts on visual resources within the flight range of the Vulcan Centaur Vehicle that significantly differ from Atlas V launches.

The Proposed Action is consistent with existing land use within the ROI as well as with the Base General Plan and the Space Force mission at VSFB. The visual presence of the proposed infrastructure is within the existing Atlas V footprint.

When considered with other past, present, and foreseeable future actions, the Proposed Action would not change the overall, cumulative negligible and less than significant effect on land use and visual resources.

5.2.2 Noise

Day-Night Average Sound Level (DNL) is used to estimate the potential long-term community annoyance to the proposed Vulcan Centaur launch operations. The DNL 60 dBA contour is used to conservatively identify the potential for significant noise impacts, as 60 dBA is the smallest level that could increase noise by DNL 1.5 dB[A] or more for a noise sensitive area that is exposed to noise at or above the DNL 65 dB[A] noise exposure level, or that will be exposed at or above this level due to the increase. The DNL contours from 60 dBA to 75 dBA are presented in ***Appendix A***. The DNL 65 and 60 dBA contours extend approximately 0.70 and 1.15 miles from the launch pad, respectively. This area does not encompass land outside of the boundaries of VSFB and no residences are impacted.[48]

The BRRC report concluded that noise impacts would not be significant based on the DNL 65 dB noise contour for the Proposed Action and the FAA reviewed the report and concurred with its conclusions

Sonic booms generated by these launch events would impact over the ocean surface beyond 40 miles off the coast and would not be audible on land; therefore, sonic booms would not produce any significant impacts in the surrounding areas.

Construction and refurbishment impacts would increase noise levels temporarily and would not be a significant impact.

The proposed Vulcan Centaur launches are not expected to generate significant propulsion noise or sonic boom impacts in the community. Community noise exposure will be less than that from previous VSFB launches. Given the overall cumulative effect of past, present, and foreseeable future actions, the Proposed Action would not have a significant impact from noise.[49]

5.2.3 Biological Resources

The Proposed Action would not be expected to have a significant impact on terrestrial vegetation and wildlife, marine species or protected species. Vulcan Centaur construction activities will have minimal impact on Biological Resources since construction activities will be within the developed SLC-3E perimeter fence and existing roadway shoulders. VSFB and ULA will comply with all relevant terms and conditions in the PBO, including avoidance and minimization measures and reporting requirements.

Acid and particulate deposition for the Proposed Action would be slightly greater than current Atlas V deposition due to anticipated use of greater quantities of solid propellants. However, Vulcan Centaur use of solid propellants is less than past Titan use. Acid and particulate impacts of the Proposed Action on vegetation is expected to be minimal with recovery of short-term launch impacts expected.

An anomaly on the launch pad would present potential impacts to biological resources from the possibility of extreme heat and fire, percussive effects of the explosion and debris that might impact land or surface waters. The explosion could injure or kill wildlife found adjacent to the launch pad or within debris impact areas. Potential fires started from the anomaly could result in a temporary loss of habitat and mortality of less mobile species.

An improbable mishap downrange would occur over the open ocean and would not likely jeopardize any wildlife, given the relatively low density of species within the surface waters of

these open ocean areas. Debris from launch failures has a small potential to adversely affect managed fish species and their habitats in the vicinity of the project area. During the April 1998 *Final Environmental Impact Statement Evolved Expendable Launch Vehicle Program*, March 2000 *Final Supplemental Environmental Impact Statement (SEIS) for the EELV Program* and November 2003 *Final Environmental Assessment, Atlas V System from SLC-3E*, consultations with NMFS determined that "no greater than minimal adverse effects" to EFH would occur under NMFS regulations.

As a result, the overall cumulative effect of other past, present, and reasonably foreseeable future actions on Biological Resources are considered minor, not significant and similar to the current Atlas V Program. When considered with other past, present, and foreseeable future actions, we anticipate that the Proposed Action would not contribute a noticeable incremental impact to the overall less than significant effect on Biological Resources.

5.2.4 Air Quality

VSFB and Santa Barbara County are in an "attainment" area, except for PM_{10}, which is "nonattainment." The operational emissions for the proposed Vulcan Centaur Program vehicle launch represent an extremely small percentage of the Santa Barbara County regional emissions and would not cause an exceedance of any CAAQS or GHG. The air quality ROI covers all of VSFB and Santa Barbara County. This includes both lower and upper atmospheres. The Proposed Action includes air emissions for construction, operations and launch.

During construction, construction activities or equipment would cause a slight increase in air emissions. However, there will not be a significant change in air emissions for Santa Barbara or VSFB.

Launch emissions for the Vulcan Centaur are expected to be similar to Atlas V or Delta IV launches with SRMs. Since LNG is a cleaner burning fuel than RP-1, PM may be reduced, but overall the emissions would be similar to current launches.

New LNG flare stack system would require a Permit to Operate and a New Source Review. Vulcan Centaur will be eliminating a currently permitted RP-1 and replacing it with the LNG flare stack system. The quantity of LNG is larger than the current quantity of RP-1, however LNG burns significantly cleaner than RP-1; therefore, pollutants are expected to decrease by removing RP-1. ULA uses no ODS in launch operations support. Vulcan Centaur launch preparation and operations support emissions are expected to be similar to the Atlas V Criteria Pollutant and HAP Emissions detailed in ***Table 4-3*** (latest data available). Therefore, we expect Proposed Action operations, even at a higher launch rate, will not significantly change the existing air emissions on VSFB. Thus, we expect no CAAQS exceedances during operations.

We considered the overall air operations cumulative effect when combined with other past, present and reasonably foreseeable future air quality actions to be similar to the current Atlas V Program. We anticipate that the Proposed Action would not contribute significantly to overall cumulative impacts on air quality.

5.2.4.1 Climate

The Proposed Action for construction, launch preparation and daily operation GHG emissions are insignificant compared to the total US GHG emissions. VSFB GHG emission totals would be unmeasurable and would not have a climate change impact. The impact of sea level rise is mitigated because SLC-3E is at a relatively high elevation. Regional and global impacts of the Proposed Action are not significant.

We consider the overall air operations cumulative effect when combined with other past, present, and reasonably foreseeable future actions on Climate to be insignificant, and we anticipate that the Proposed Action would not noticeably impact Climate.

5.2.5 Orbital and De-orbiting Debris

Although the Vulcan Centaur upper stage is larger than the current Atlas V Centaur upper stage, the environmental impact of orbiting and de-orbiting debris is similar. Implementation of the Proposed Action would not likely change the total number of worldwide space launches. Thus, no significant global effect on orbital/deorbiting debris would be incurred from the implementation of the Proposed Action. This SEA compared the anticipated Vulcan Centaur orbiting and de-orbiting debris impacts to the current Atlas V orbital and reentry debris impacts as documented in the November 2011 *Environmental Assessment for Launch of NASA Routine Payload.*[50] The analysis determined that the anticipated Vulcan Centaur orbiting and de-orbiting debris impacts are within the scope of the 2011 NASA Routine Payload EA and are therefore categorically excluded from this NEPA evaluation. If future, unanalyzed payloads or launch vehicle configurations pose potential environmental consequences, separate NEPA evaluation(s) will be performed for each unique payload program or launch vehicle configuration or launch vehicle configuration, as required.

The cumulative effect of other past, present, and reasonably foreseeable future actions would not be significant to orbital and de-orbiting debris. When considered with other past, present, and foreseeable future actions, we anticipate that the Proposed Action would not contribute a noticeable incremental impact on orbital and de-orbiting debris globally.

5.2.6 Hazardous Materials and Solid and Hazardous Waste

Hazardous materials proposed for use in launch operations and construction supporting the Vulcan Centaur Program are used in support of the Atlas V operations, except for LNG and LN_2. These materials would be handled, stored and disposed of per manufacturer specifications and Federal and State regulations. Existing Atlas V handling and management procedures for hazardous materials, hazardous wastes, and solid wastes will be applied during to the Vulcan Centaur Program, limiting the potential for negative impacts.

The cumulative effect of other past, present, and reasonably foreseeable future actions would not be significant to hazardous materials and solid and hazardous waste impacts. When considered with other past, present, and foreseeable future actions, the Proposed Action would be a negligible contribution to hazardous materials and solid and hazardous waste impacts.

5.2.7 Water Resources

The Proposed Action would have no significant impact on surface water, groundwater, floodplains and wetlands.

BMPs during construction will prevent and minimize dispersion of soils and pollutants to surface waters. Water usage quantities are increased by 7,600-gallons per launch. ULA has never inadvertently discharged wastewater, so no impacts on surface water are expected. If a launch abort or failure happens, debris could land in the ocean or other surface waters. Impacts to surface waters from a launch anomaly are similar to current Atlas V launches. Increased SRM use could decrease exhaust cloud pH slightly, but we expect its deposition to not significantly impact surface water.

The conditions of the General Waiver for Specific Discharges minimize and prevent impacts to groundwater and surface water. ULA's safety and operating procedures minimize the risk of groundwater contamination by fuels or other hazardous liquids. We expect no significant impact to groundwater from the Proposed Action.

The cumulative effect of other past, present, and reasonably foreseeable future actions on water resources are not significant and would be similar to the current Atlas V. When considered with other past, present, and foreseeable future actions, we anticipate that the Proposed Action would not contribute a noticeable incremental impact on water resources.

5.2.8 Transportation

Transportation consists of construction, operations and launch impacts. A slight increase in the traffic during the approximate 36-month period of construction is anticipated, but it would not significantly impact VSFB roadways. The Vulcan Centaur boosters and PLF will be manufactured in Decatur, AL, brought to the port, and travel through the Panama Canal to VSFB. The boosters will be transported to the VIF. The PLF will be transported into VSFB from SR 256. Refer to ***Appendix A, Figure 2. Vicinity Map.*** for details. Since this transportation route is identical to Atlas V, it is not expected to have a significant impact to VSFB transportation routes given only a small increase in the number of future Vulcan Program anticipated launches. During launches, the increase in traffic should be similar to existing launches and would not be significant.

The cumulative effect of other past, present, and reasonably foreseeable future actions would not be significant to VSFB roadways. When considered with other past, present, and foreseeable future actions, we anticipate that the Proposed Action would not contribute a noticeable incremental impact to regional or local transportation assets.

5.2.9 Utilities

The Proposed Action water requirements are well within the design availability and capacity would generate no significant impacts on water supply. The Vulcan Program does not anticipate adding personnel, so domestic wastewater generation is anticipated to remain the same as the Atlas V Program's generation. Construction personnel do not add appreciably to the sanitary sewer load as the contractor is required to provide on-site sanitary facilities.

The Vulcan Centaur Program power requirements are similar to the Atlas V Program and no additional electrical power supply needs have been defined. The Proposed Action would have no significant impact on available electrical power supply.

Stormwater permitting at SLC-3E will occur due to the Proposed Action. Since the construction area exceeds one acre, a NPDES Stormwater Construction Permit would be required and a SWPPP would be implemented. The Proposed Action is not expected to have a significant impact on stormwater.

As a result, we considered the overall cumulative effect of other past, present, and reasonably foreseeable future actions on utilities will be negligible and not significant in the context of supply. When considered with other past, present, and foreseeable future actions, we anticipate that the Proposed Action would not contribute a noticeable incremental impact on utilities.

5.2.10 Socioeconomics

We anticipate the Vulcan Centaur launch preparation timeframe and personnel requirements to be similar to Atlas V requirements and will not impact population or growth rate of the region. Construction and refurbishment activities for the Proposed Action would result in a temporary and minor increase in the number of personnel on VSFB. This increase would not represent a significant increase in the population or growth rate of the region, since most construction personnel already live and work in the area. The Proposed Action would generate no negative socioeconomic impacts on the region.

The Proposed Action will have a slightly positive influence on socioeconomics, through contributions to the local economy. As a result, the overall cumulative effect of other past, present, and reasonably foreseeable future actions on socioeconomics is considered beneficial and not significant. When considered with other past, present, and foreseeable future actions, we anticipate that the Proposed Action would contribute a noticeable incremental beneficial minor and less than significant impact on socioeconomics.

6 Applicable Environmental Requirements

6.1 Federal Regulations Regarding Environmental Quality

The NEPA (42 USC §§ 4321-4347, as amended) requires Federal agencies to analyze the potential environmental impacts of major Federal actions and alternatives and to use these analyses as a decision-making tool on if and how to proceed with the Proposed Action or Alternatives.

6.2 Federal Regulations Regarding Biological Resources

Public Law 93-205 requires military installations to protect and conserve Federally-listed, endangered, and threatened plants and wildlife.

The ESA of 1973 declares Congress' intention to conserve T&E species and the ecosystems on which those species depend. The Act requires that Federal agencies, in consultation with the USFWS and NOAA Fisheries, use their authorities in furtherance of its purposes by carrying out programs for the conservation of T&E species. Section 7 of the ESA (16 USC § 1536) contains provisions that require Federal agencies to consult with the Secretary of Interior and to take necessary actions to ensure that actions authorized, funded, or carried out by those Federal agencies do not jeopardize the continued existence of endangered species and threatened species. Federal agencies must ensure that actions taken will not result in the destroying or modifying endangered species habitat.

The Marine Mammal Protection Act (16 USC § 1361, et seq.), Section 101(a)(5)(A), directs the Secretary of Commerce to allow, upon request, the incidental, but not intentional, taking of marine mammals by US citizens who engage in a specified activity (other than commercial fishing) within a specified geographical region if certain findings are made and regulations are issued. Permission may be granted for periods of five years or less if the NMFS finds that the taking will have a negligible impact on the species or stock(s); will not have an unmitigable adverse impact on the availability of the species or stock(s) for subsistence uses; and the permissible methods of taking and requirements pertaining to the monitoring and reporting of such taking are set forth.

The Marine Mammal Protection Act prohibits harassing or killing any marine mammal. Harassment is any act of pursuit, torment, or annoyance which has the potential to injure a marine mammal or marine mammal stock in the wild by causing disruption of behavioral patterns, including, NMFS imposed marine mammal observation distance requirements.

The California Endangered Species Act (CESA) establishes the conservation and wise management of T&E species as State law. Agencies are required to consider impacts to T&E species when planning and implementing projects, as mandated by California law.

The Magnuson-Stevens Fishery Conservation and Management Act (Sustainable Fisheries Act) identifies EFH and threats to EFH. This Act requires consultation with NMFS to ameliorate any threats to EFH from non-fishing activities.

6.3 Federal Regulations Regarding Cultural Resources

The NHPA of 1966 (Public Law 89-665), as amended; EO 11593 of 1971 (36 CFR Part 154); the AIRFA of 1978 (Public Law 95-341); the ARPA of 1979 (Public Law 96-95); the NAGPRA of 1990 (Public Law 101-601); and the AFI for cultural resource management of 1994 (AFI 32-7065). Daily, cultural resource management on VSFB is guided primarily by the NHPA and its implementing regulations, 36 CFR Part 800. Briefly, Section 106 requires Federal agencies to consider the effect of any undertaking on any district, site, building, structure, or object that is on or potentially eligible for the National Register. An undertaking is defined as "a project, activity, or program funded in whole or part under the direct or indirect jurisdiction of a Federal agency, including those carried out by or on behalf of a Federal Agency; those carried out with Federal financial assistance; those requiring a Federal permit, license, or approval; and those subject to State or local regulation administered pursuant to a delegation or approval by a Federal agency" [36 CFR Part 800.16(y)]. For any undertaking, the Section 106 process requires identifying historic properties (i.e., those on or eligible for the National Register), assessing potential adverse project effects on any historic properties, and resolving adverse effects in consultation with the SHPO and/or, if necessary, the Advisory Council on Historic Preservation.

The Archaeological Resource Protection Act was passed in 1979 to protect archaeological resources and sites on public lands and requires a permit for any excavation or removal of archaeological resources from public lands.

The NAGPRA and its implementing regulations, 43 CFR Part 10, provides ownership or control of Native American human remains and selected cultural items excavated or discovered on Federal lands with designated Native American tribes, organizations, or groups. If human remains or certain cultural items are discovered on Federal lands, the appropriate Native American group must be notified. AFMAN 32-7003 provides guidance for complying with relevant extant authorities.

6.4 Federal Regulations Regarding Air Quality

The Proposed Action is regulated by the following Federal CFR Titles listed and discussed below:

Title 40 CFR Part 50 National Ambient Air Quality Standards (NAAQS): The CAA required the EPA to establish ambient ceilings for certain criteria pollutants. Subsequently, the EPA promulgated regulations that set NAAQS. Two classes of standards were established: primary and secondary. Primary standards prescribe the maximum permissible concentration in the ambient air required to protect public health. Secondary standards specify levels of air quality required to protect public welfare, including materials, soils, vegetation, and wildlife, from any known or anticipated adverse effects. The criteria pollutants for which the NAAQS have been established include CO, nitrogen dioxide, ozone, PM_{10}, $PM_{2.5}$, and SO_2.

The EPA classifies air quality within each Air Quality Control Region with regard to its attainment of Federal primary and secondary NAAQS. According to EPA guidelines, an area with air quality better than the NAAQS for a specific pollutant is designated as in attainment for that pollutant. Any area not meeting ambient air quality standards is classified as nonattainment. When there is a lack of data for the EPA to define an area, the area is designated as unclassified and treated as an attainment area until proven otherwise.

Title 40 CFR Part 51 Subpart W (General Conformity): General conformity rule applies to Federal actions that are not covered by transportation conformity rule, with several listed exceptions. Other than the listed exemptions and presumptions of conformity, general conformity applies to actions in which projected emissions exceed applicable conformity *de minimis* thresholds. However, if the emissions from a Federal action do not equal or exceed *de minimis* thresholds but do represent 10 percent or more of a nonattainment or maintenance area's total emissions of any criteria pollutant, the action is considered "regionally significant" and the requirements of conformity determination apply.

Title 40 CFR Part 61 (NESHAP): The National Emissions Standards for Hazardous Air Pollutants regulates stationary sources with a prescribed standard under Title 40 CFR Part 61. Such stationary sources may be required to obtain an operating permit issued by an authorized Air Pollution Control agency or by EPA in accordance with Title V of the CAA. The NESHAP identifies and list a variety of HAPs that are regulated.

Title 50 CFR Part 63 Subpart GG for manufacturers of commercial, civil, or military aerospace vehicles or components and that are major sources of hazardous air emissions. Such emissions would result from cleaning operations, surface coating with primers and topcoats, paint removal, and waste storage.

Hazardous wastes that are subject to RCRA requirements would be exempt from the subpart. Those wastes would include specialty coatings, adhesives, primers, and sealant materials at aerospace facilities. Other exemptions would include HAPs or VOC contents less than 0.1 percent for carcinogens or 1.0 percent for non-carcinogens and low volume coatings.

Title 40 CFR Part 70 (State Operating Permit Programs): Per Title V of the CAA large facilities that are capable of producing large amounts of air pollution are required to obtain an operating permit. Permits are issued by a District. Typical activities that require the CAA Title V permit include any major source (source that emits more than 100 tons per year of criteria pollutant in a nonattainment area for that pollutant or is otherwise defined in Title I as a major source); affected sources as defined in Title IV; sources subject to Section 111 regarding New Source Performance Standards; sources of air toxics regulated under Section 112 of the CAA; sources required to have new source or modification permits under Parts C or D of Title I of the CAA; and any other source such as hazardous waste pollutants designated by EPA regulations.

Part 70 Federal Operating Permits are issued to specific emission sources. Sources requiring permits are determined based on the source's potential to emit certain threshold levels of pollution given their equipment and processes. Facilities requiring Part 70 Federal Operating Permits include sources with the potential to emit the following:

HAP amounts equal to or greater than: 100 tons/year of any regulated air pollutant; 10 tons/year of any individual HAP or 25 tons/year of a combination of HAPs; or lesser quantity thresholds for any HAP established by the EPA rulemaking. Any stationary source defined by the EPA as major for the District under Title I, Part D (Plans for Nonattainment Areas) of the CAA and its implementing regulations including:

For ozone nonattainment areas, sources with the potential to emit 100 tons per year or more of volatile organic compounds or oxides of nitrogen in areas classified as "marginal" or "moderate," 50 tons per year or more in areas classified as "serious," 25 tons per year or more in areas classified as "severe," and 10 tons per year or more in areas classified as "extreme";

- Acid rain sources included under the provisions of Title IV of the CAA and its implementing regulations.
- Any source required to have a pre-construction review permit pursuant to the requirements of the New Source Review/Prevention of Significant Deterioration program under Title I, Parts C and D of the CAA and its implementing regulations;
- Any solid waste incineration unit required to obtain a Part 70 permit pursuant to Section 129(e) of the CAA and its implementing regulations; and
- Any stationary source in a source category required to obtain a Part 70 permit pursuant to regulations promulgated by the EPA Administrator.

Title 49 CFR Parts 100-199: Liquid propellant for the Vulcan Centaur vehicle must be shipped and handled in accordance with Title 49 CFR Parts 100-199. The liquid propellants would be shipped directly from the manufacturing location to the launch site.

6.5 Federal Regulations Regarding Hazardous Waste/Hazardous Materials

The CERCLA of 1980 responds to the immediate cleanup of hazardous waste contamination from accidental spills or from waste disposal sites that may result in long-term environmental damage.

The RCRA of 1974 (42 USC. 6901 et seq.) was designed to control the handling and disposal of hazardous substances by responsible parties. Hazardous waste, as defined by RCRA, is a "waste that may cause or significantly contribute to serious illness or death, or that poses a substantial threat to human health or the environment when improperly disposed." The treatment, storage, and disposal of solid waste (both hazardous and nonhazardous) is regulated under the Solid Waste Disposal Act as amended by RCRA and the Hazardous and Solid Waste Amendments of 1984.

The SARA of 1986, Title III: EPCRA establishes standards for community right-to-know programs and requires the reporting of releases of certain toxic chemicals. Local planning committees, comprising government, news media, industry, environmental, organizations, and medical representatives, receive right-to-know information from facilities. Facilities with Standard Industrial Classification codes between 20 and 39 that manufacture, process, or otherwise use listed toxic chemicals, must report a release of these toxic chemicals to the environment, in greater than reportable quantities, on a Form R.

Under 49 CFR Part 170 are DOT requirements for the shipment of hazardous materials. This section specifies the proper container type, shipping name, and labeling requirements for the transportation of hazardous materials.

The Toxic Substances Control Act of 1976 regulates chemical substances and mixtures that present an unreasonable risk of injury to health, or the environment, and acts with respect to chemical substances and mixtures which are imminent hazards.

6.6 Federal Regulations Regarding Water Resources

The CWA (33 USC § 1251 et seq.) prohibits the discharge of pollutants from a point source into navigable waters of the US, except in compliance with a NPDES (40 CFR Part 122) permit. The

navigable waters of the US are considered to encompass any body of water whose use, degradation, or destruction will affect interstate or foreign commerce.

Section 402 of the CWA requires that the EPA establish regulations for issuing permits for stormwater discharges associated with industrial activity. A NPDES permit is required if activities involve the disturbance of one to five acres of land. A Notice of Intent must be submitted by ULA and a SWPPP must be developed.

Section 404 establishes a program to regulate the discharge of dredged and fill materials into waters of the US, including wetlands. Activities in waters of the US that are regulated under this program include fills for development, water resource projects (such as dams and levees), infrastructure development (such as highways and airports), and conversion of wetlands to uplands for farming and forestry. EPA and the United States Army Corps of Engineers (USACE) jointly administer the program. In addition, the USFWS, NOAA Fisheries, and State resource agencies have important advisory roles.

6.7 Federal Regulations Regarding Environmental Justice

EO 12898 (Federal Actions to Address Environmental Justice in Minority Populations and Low-Income Populations) requires that all Federal agencies develop environmental justice strategies and make environmental justice a part of their mission by identifying and addressing, as appropriate, any disproportionate and adverse human health or environmental effects of their activities on minority or low-income populations.

6.8 State of California Regulations

State regulations are contained generally in the CCRs. Pertinent requirements include: obtaining NPDES permits for construction and industrial discharges per the State Water Resources Control Board, Central Coast Region requirements; Title V Air construction and operation permits through SBCAPCD; and hazardous materials and wastes control per the Department of Toxic Substances Control.

7 Persons and Agencies Contacted

Table 7-1: Persons and Agencies Contacted

Name / Title	Company/Agency	Address
Atta, Amena / Installation Restoration Program	30 CES/AFCEC-CZOW	1028 Iceland Ave Vandenberg SFB, CA 93437-6010
Curry-Bumpass, Tracy / Environmental Planner	30 CES/CEIEA	1028 Iceland Ave Vandenberg SFB, CA 93437-6010
Evans, Rhys / Natural Resources	30 CES/CEIEA	1028 Iceland Ave Vandenberg SFB, CA 93437-6010
Ryan, Christopher / Cultural Resources	30 CES/CEIEA	1028 Iceland Ave Vandenberg SFB, CA 93437-6010
York, Darryl L. / Chief of Conservation	30 CES/CEIEA	1028 Iceland Ave Vandenberg SFB, CA 93437-6010
Harding, Kimberlee / Air Quality	30 CES/CEIEC	1028 Iceland Ave Vandenberg SFB, CA 93437-6010

The California State Clearinghouse reviews SEAs for projects planned in California pursuant to CEQA, CCR Title 14, Section 15000-15387 and Presidential Executive Order (EO) 12372; the Coastal Zone Management Act; 16 U.S.C. SS 1451-1464 as amended; and NEPA, 42 U.S.C. §4321, §§4331–4335, and §§4341–4347. The State Clearinghouse sends copies of the draft SEA to applicable State regulatory agencies for review and submits any comments to be addressed in the final SEA. Therefore, this SEA will be submitted for Clearinghouse review. Other Federal and State agency coordination, approval and permits will include as necessary:

- Consultation with the USFWS pursuant to the Federal ESA and the MBTA
- Informal Consultation with the NMFS pursuant to the Federal MSFCMA, the Marine Mammal Protection Act (MMPA), and ESA
- Coordination with DOT to renew and/or maintain transportation permits
- Consultation with SHPO
- California Environmental Protection Agency
- Santa Barbara County Air Pollution Control District
- USACE CWA Section 404 permit
- Tribal Consultations

The USSF invites public participation in decision-making on new proposals through the NEPA process. Public participation with respect to decision-making on the Proposed Action is guided by 32 CFR Part 989.

Consideration of the views and information of all interested persons promotes open communication and enables better decision-making. Copies of the draft EA will be made available to the public in local public libraries and SLD 30 Public Affairs Office at Vandenberg Space Force Base. A Notice of Availability (NOA) will be published in the local newspaper announcing the availability of the documents for a 30-day review period. The State Clearinghouse will provide responses to the draft SEA, and responses to comments will be included in the Final SEA.

8 List of Preparers

Table 8-1: Preparer Details

Name / Company	Title / Responsibility	Education	Years of Experience
Burns, Imogene Nelson Engineering Co.	Environmental Specialist	B.B.A.	19
Seringer, Carrie Nelson Engineering Co.	Vice President	B.S. Chemical Engineering	30+
Longshore, Jeffrey Nelson Engineering Co.	Director, Civil and Environmental Engineering	B.S. Civil Engineering	15
Koci, Josh Nelson Engineering Co.	Civil/Environmental Engineer	B.S. Environmental Engineering	5
Toner, Brad Nelson Engineering Co.	Aerospace Engineer	B.S. Aerospace Engineering	2
Nevitt, Duane ULA	Automation Systems Manager/ Facility Power Systems and Environmental Monitoring Control Systems	B.S. Electronic Engineering	30+
Inboden, Toby ULA	System Safety Engineer	M.S. Engineering Management and Technology	30+
Smoots, Neil ULA	Mechanical Engineer	Civil/Mechanical Engineer	30+
Quintanilla, Jorge A. ULA	Mechanical Engineering Lead	B.S. Welding Engineer	30+

9 References and Documents Cited

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10 Endnotes

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[47]EELV EIS, 2000
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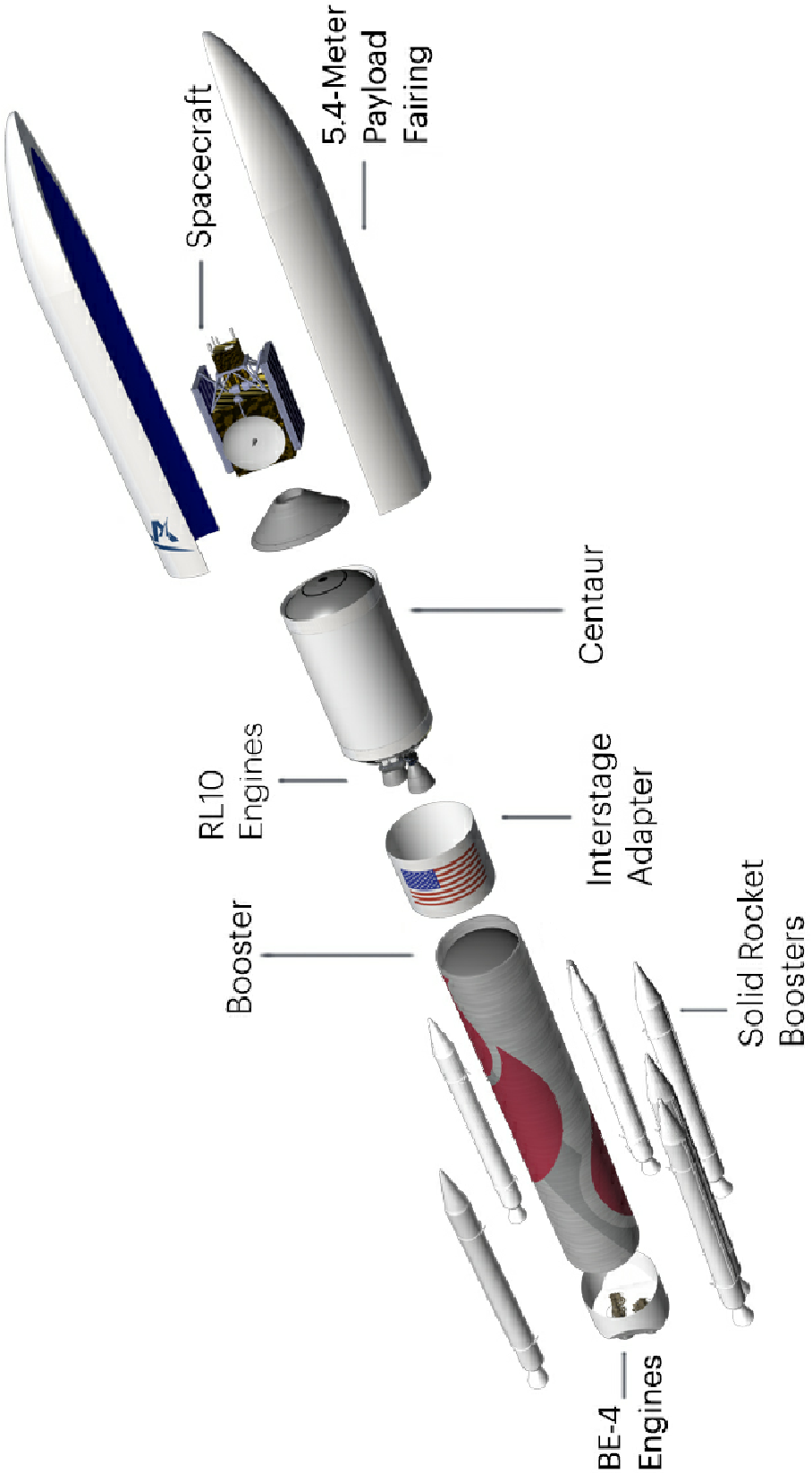
APPENDIX A

Figures



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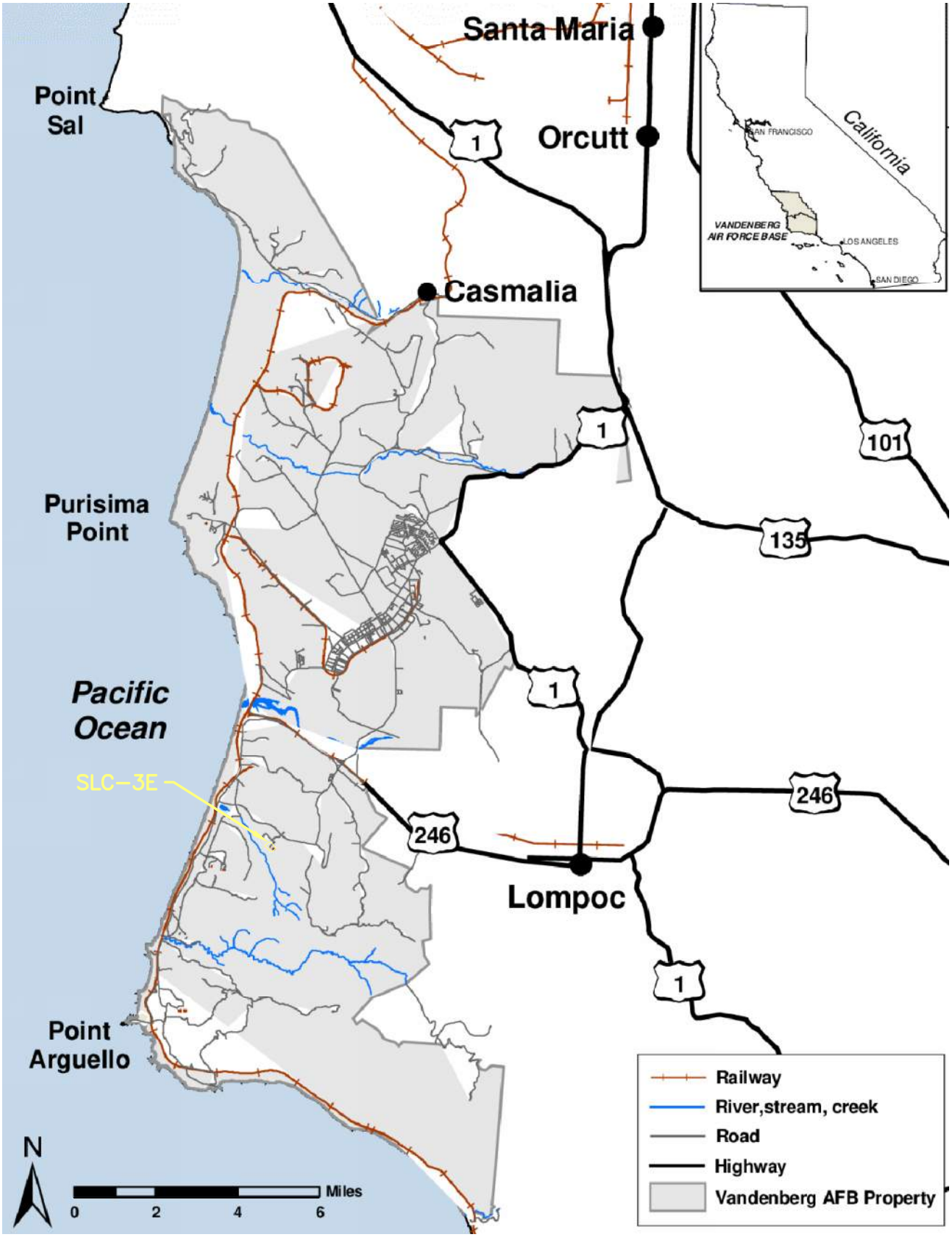
www.NelsonEngrCo.com

Source: ULA

SHEET TITLE
ULA Vulcan - VAFB SLC-3E
Vulcan Centaur Vehicle Configuration

DATE
7-1-2021

FIGURE: 1



Source: Environmental Assessment - Security and Safety Upgrades to Entry Control Facilities, VAFB, CA 8 July 2009

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SHEET TITLE

ULA Vulcan - VAFB SLC-3E
Vicinity Map

DATE
7-1-2021

FIGURE: 2

GRAPHIC SCALE

1000' 500' 0 1000'

1"=1000'

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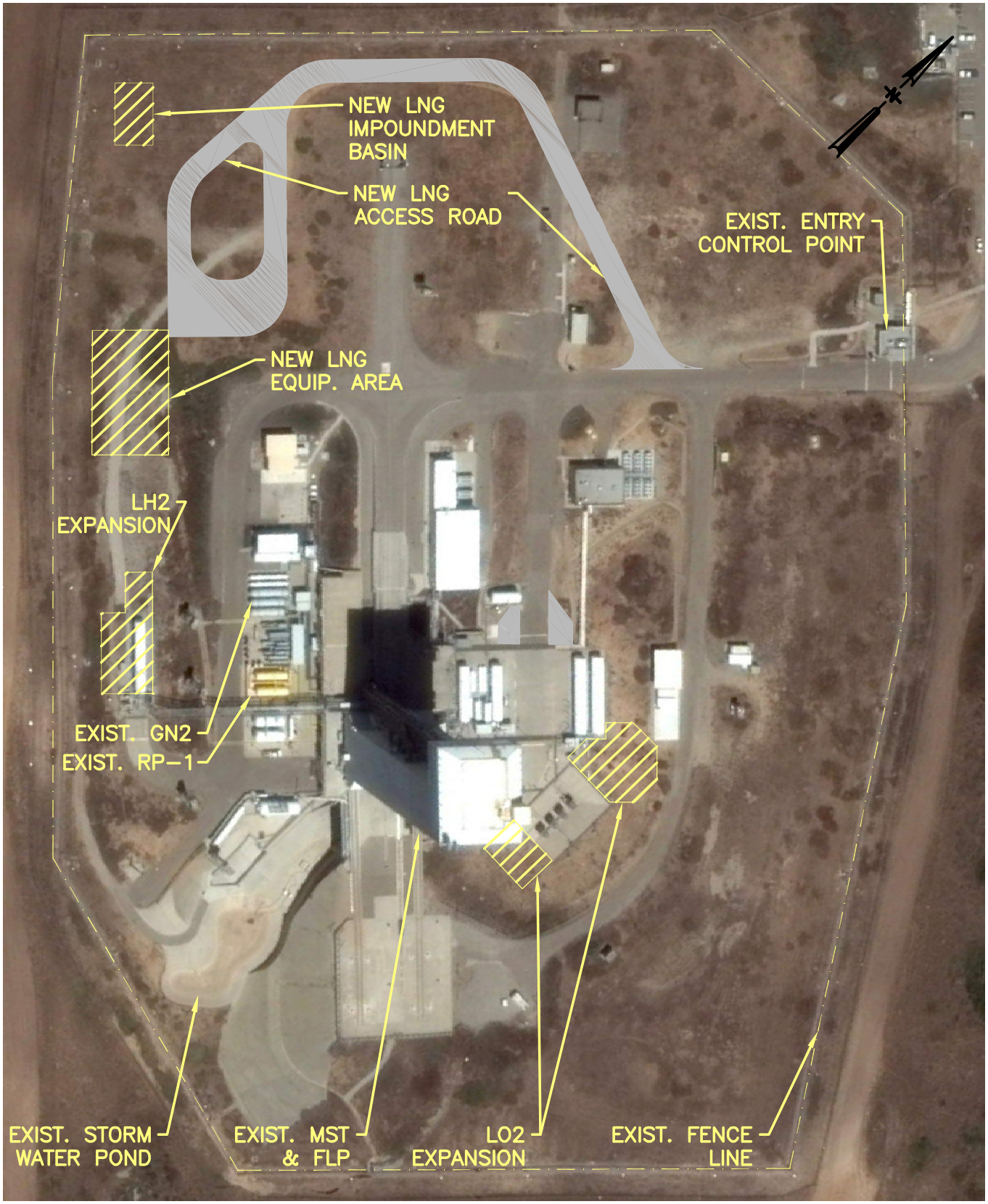
Source: Google Earth

SHEET TITLE

ULA Vulcan - VAFB SLC-3E
Location Map

DATE
7-1-2021

FIGURE: 3



GRAPHIC SCALE

150' 75' 0 150'

1"=150'

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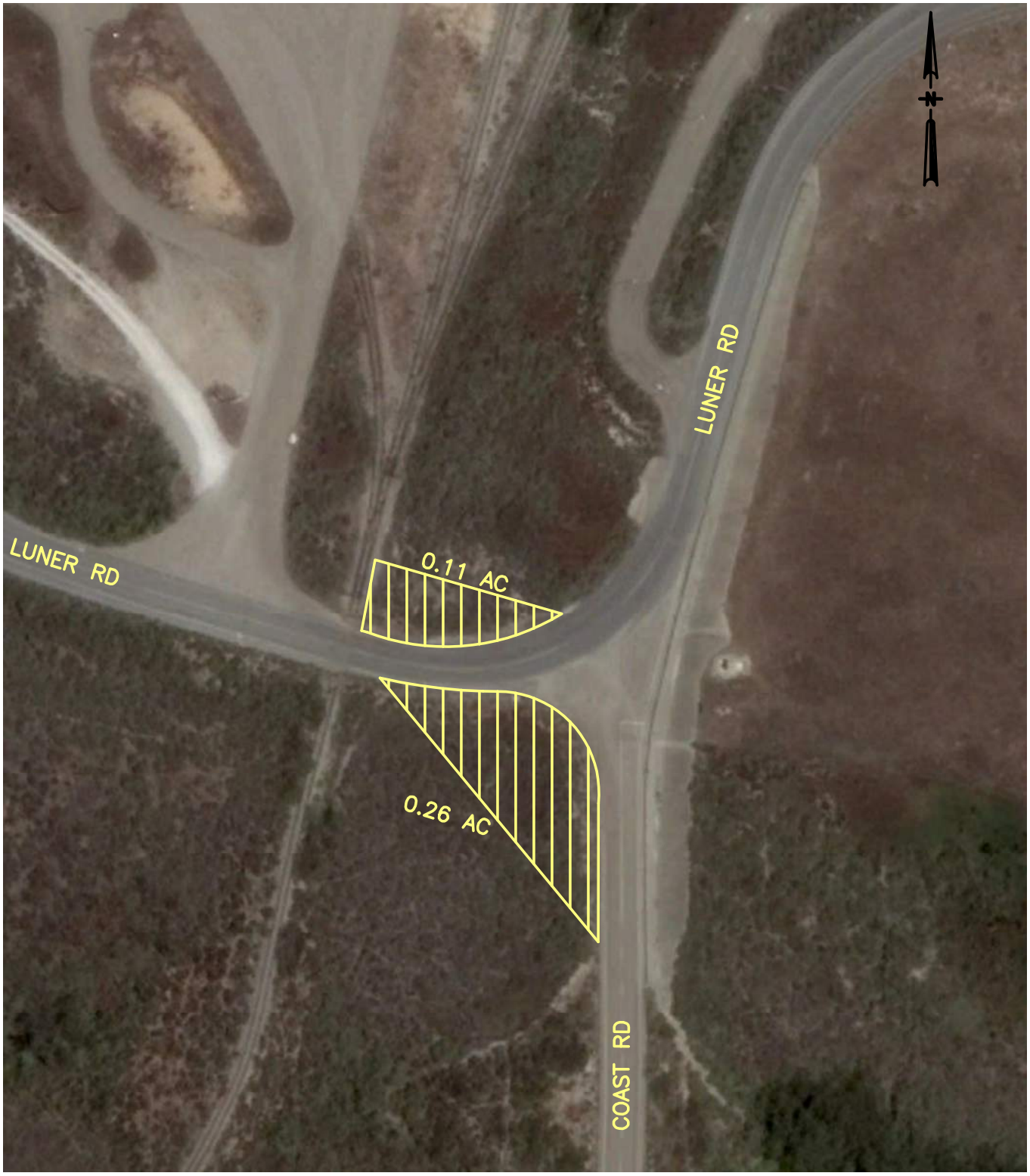
SHEET TITLE

ULA Vulcan - VAFB SLC-3E
Vulcan Centaur SLC-3E Site Modifications

DATE
7-1-2021

FIGURE: 4



LEGEND

IMPACT AREA

GRAPHIC SCALE

100' 50' 0 100'

1"=100'

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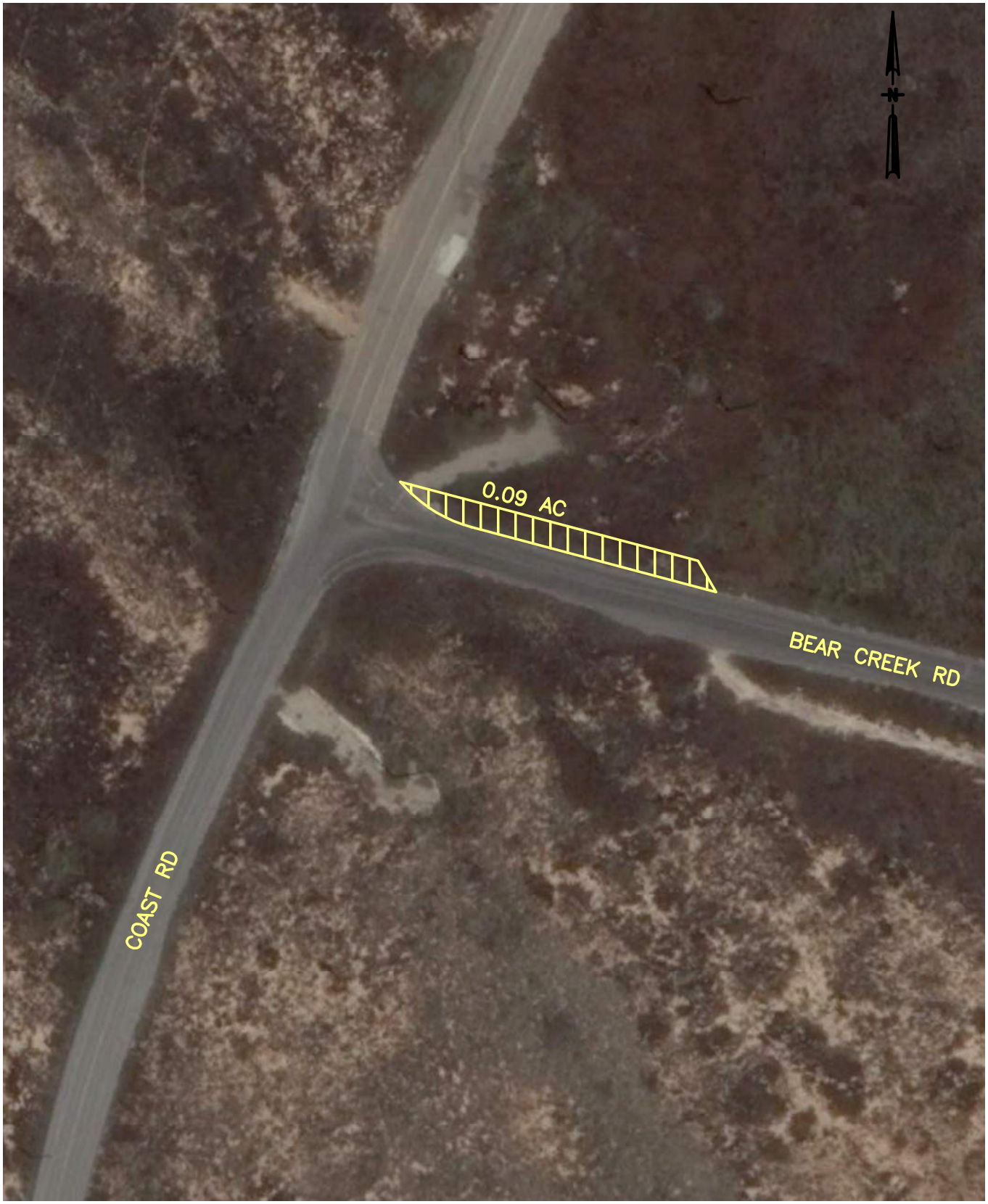
SHEET TITLE

ULA Vulcan - VAFB SLC-3E - Luner Rd and Coast Rd Intersection Modifications

DATE

7-1-2021

FIGURE: 5



LEGEND

IMPACT AREA

GRAPHIC SCALE

100' 50' 0 100'

1"=100'

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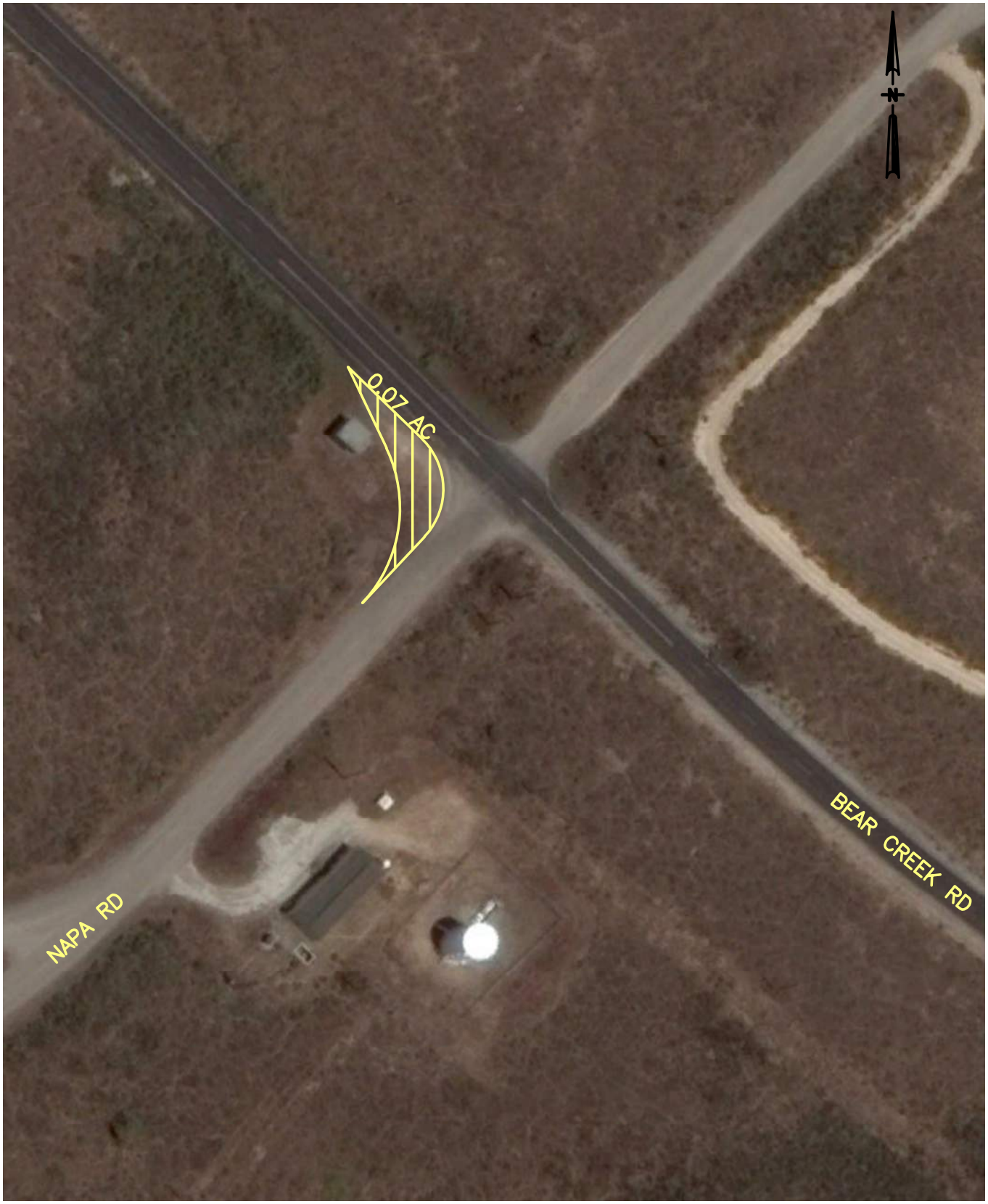
SHEET TITLE

ULA Vulcan - VAFB SLC-3E - Coast Rd and Bear Creek Rd Intersection Modifications

DATE

7-1-2021

FIGURE: 6



LEGEND

IMPACT AREA

GRAPHIC SCALE

100' 50' 0 100'

1"=100'

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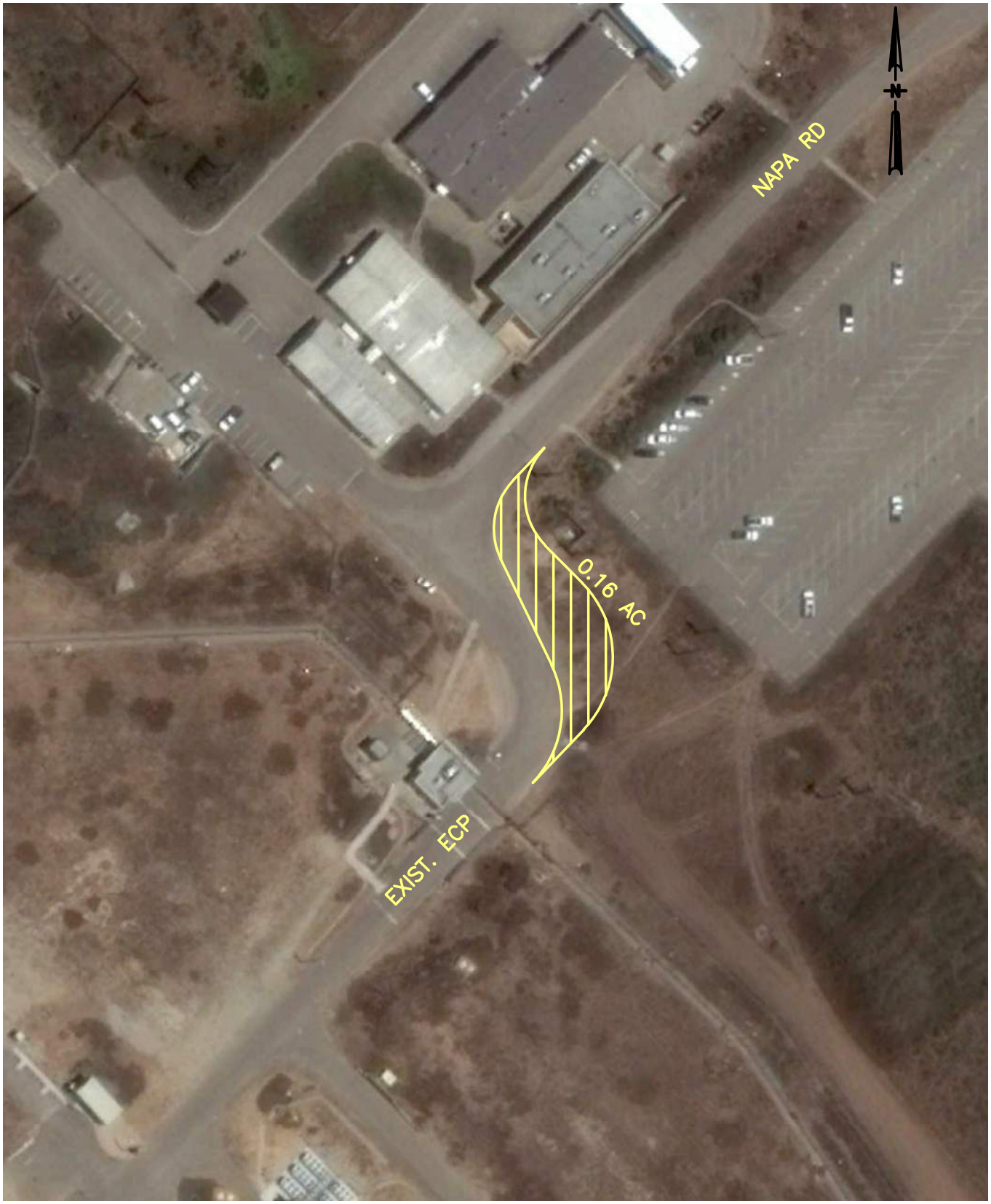
SHEET TITLE

ULA Vulcan - VAFB SLC-3E - Bear Creek Rd and Napa Road Intersection Modifications

DATE

7-1-2021

FIGURE: 7



LEGEND

IMPACT AREA

GRAPHIC SCALE

100' 50' 0 100'

1"=100'

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SHEET TITLE

ULA Vulcan - VAFB SLC-3E
Entry Control Point Modifications

DATE

7-1-2021

FIGURE: 8

LEGEND

IMPACT AREA

GRAPHIC SCALE

150' 75' 0 150'

1"=150'

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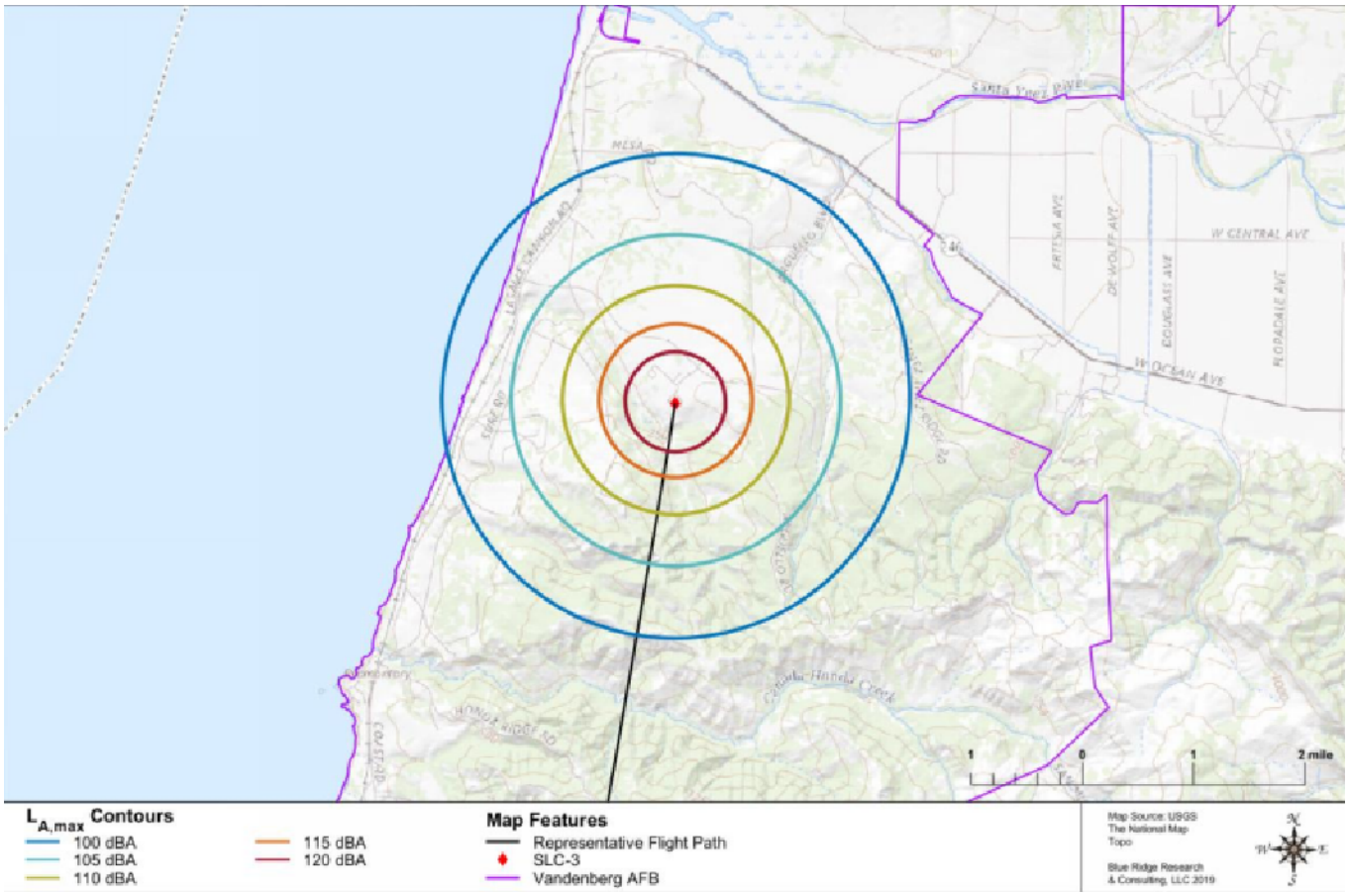
SHEET TITLE

ULA Vulcan - VAFB SLC-3E - Utah Avenue and 10th Street Intersection Modifications

DATE

7-1-2021

FIGURE: 9



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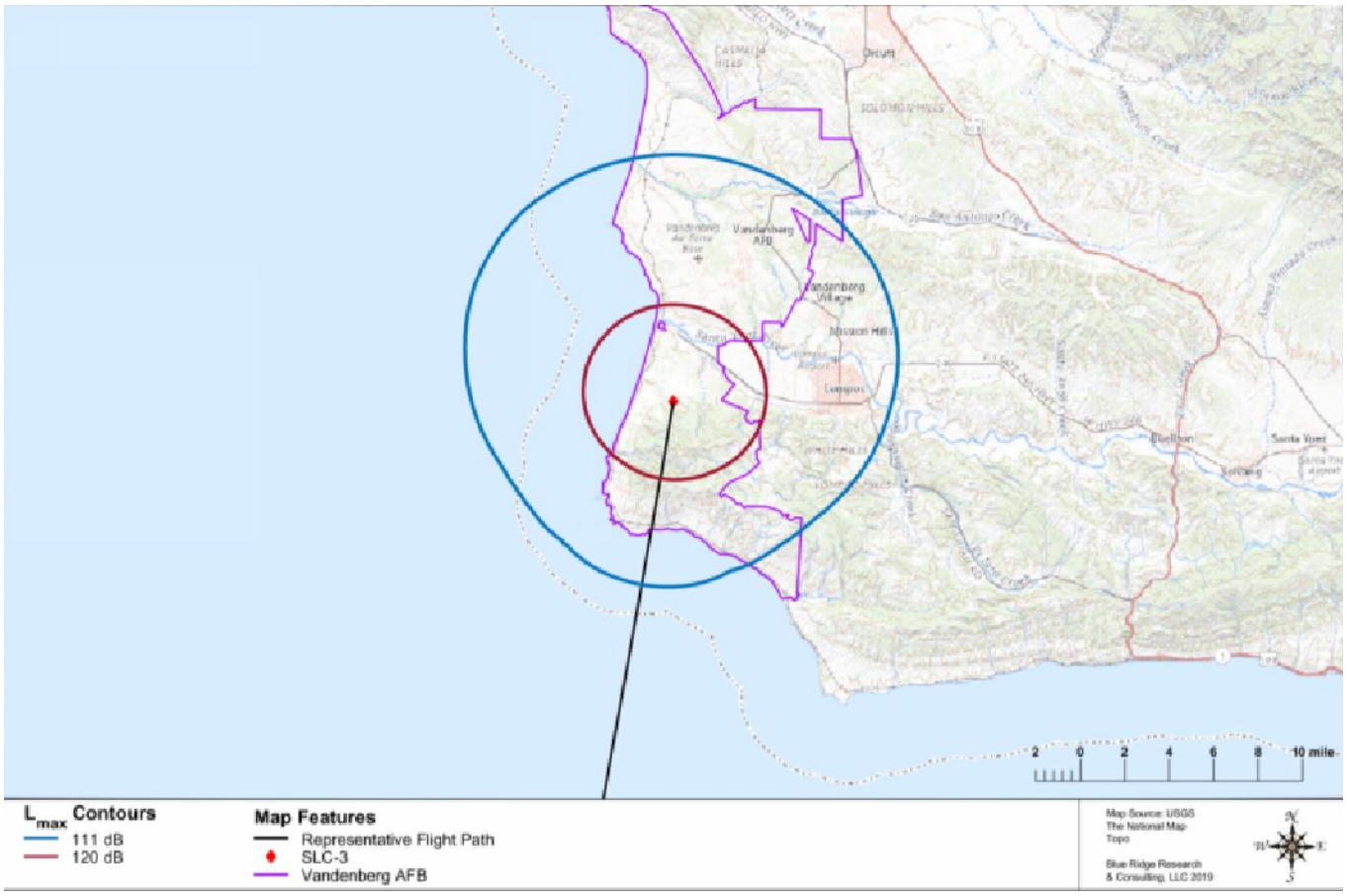
SHEET TITLE

ULA Vulcan - VAFB SLC-3E - LA,max for Vulcan Centaur (single core and six SRB's)

DATE

7-1-2021

FIGURE: 10



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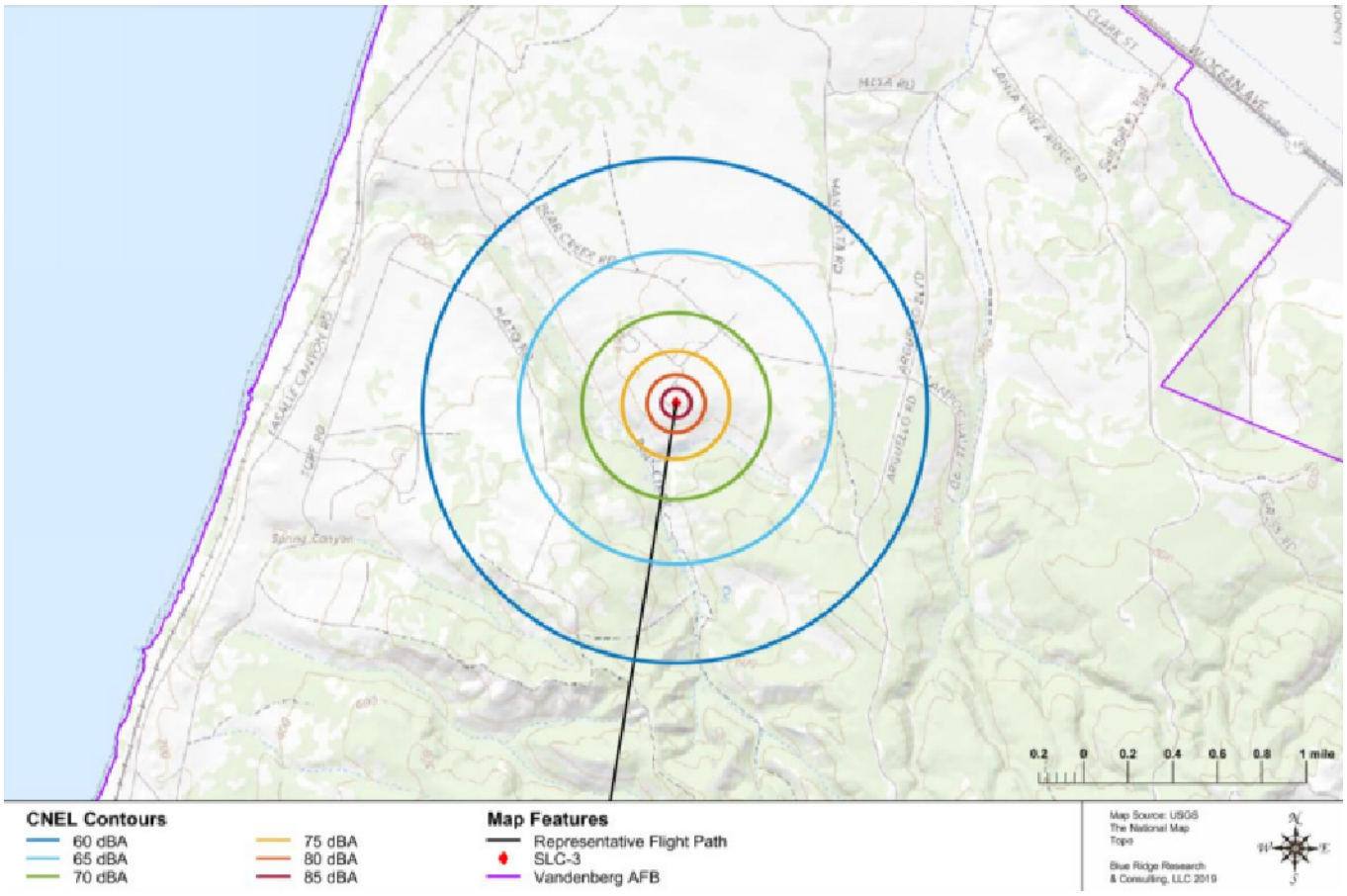
SHEET TITLE

ULA Vulcan - VAFB SLC-3E - Lmax for Vulcan Centaur (single core and six SRB's)

DATE

7-1-2021

FIGURE: 11



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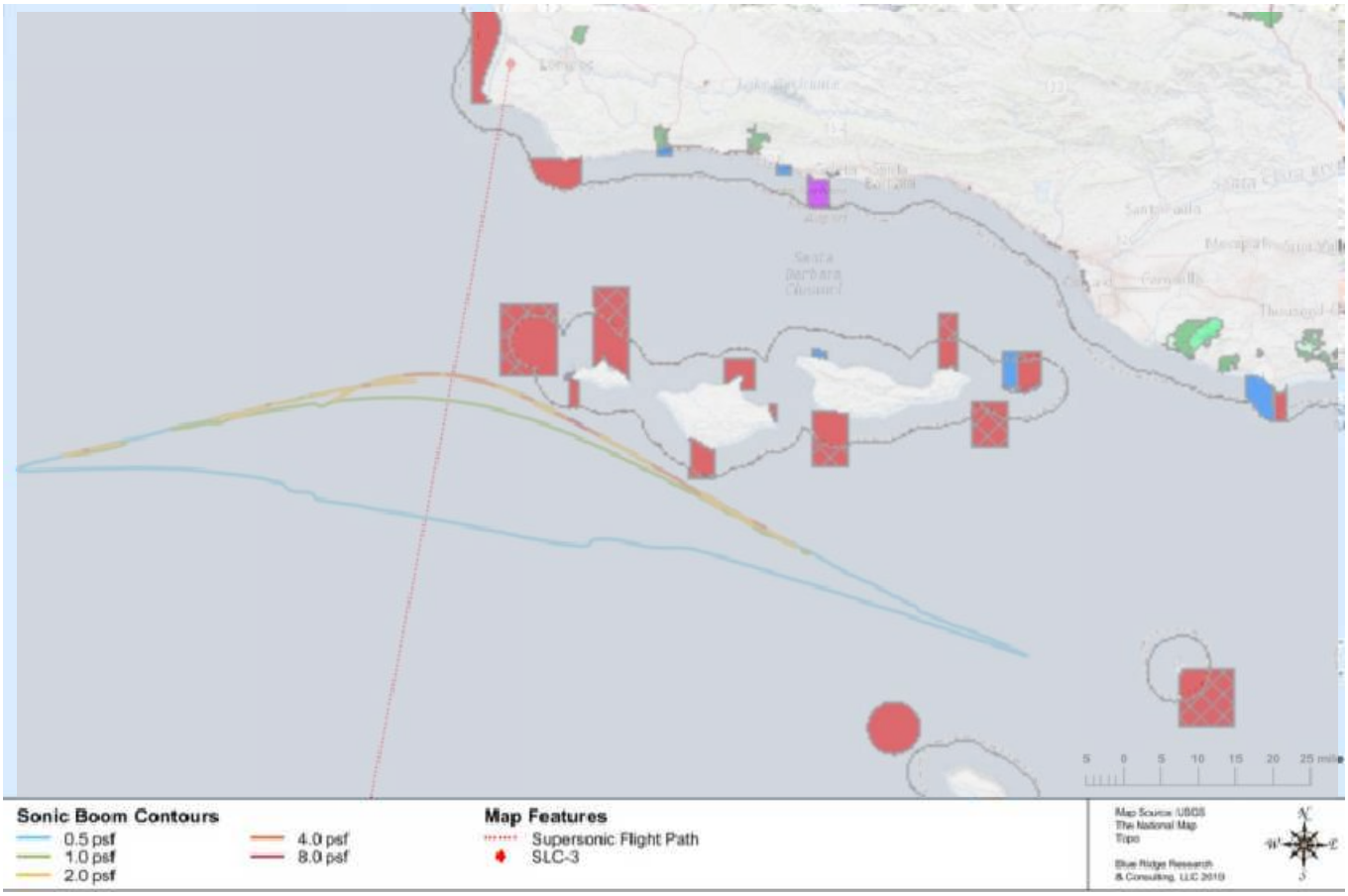
SHEET TITLE
ULA Vulcan - VAFB SLC-3E - CNEL for Vulcan Centaur (single core and six SRB's)

DATE
7-1-2021

FIGURE: 12



LEGEND

- Federal Marine Conservation Area
- Federal Marine Reserve
- State Marine Reserve (SMR)
- State Marine Conservation Area SMCA (No-Take)
- State Marine Conservation Area (SMCA)
- State Marine Park (SMP)
- State Marine Recreational Management Area (SMRMA)
- Special Closure
- Area of Special Biological Significance
- Designated Marine Managed Areas
- Lands Operated by Others
- Cooperative Management Areas
- Cultural Preserve
- Divested Units and Properties
- Natural Preserve
- Park Unit or Property
- Properties not Operated as State Park Units
- Special Use Areas
- State Wilderness

Source: California Department of Fish and Wildlife

BRRC BLUE RIDGE RESEARCH AND CONSULTING

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SHEET TITLE
ULA Vulcan - VAFB SLC-3E - Sonic Boom Peak Overpressure Nominal Vulcan Centaur

DATE
7-1-2021

FIGURE: 13

Map Unit Symbol	Map Unit Name	Acres in AOI	Percent of AOI
ArF	Arnold sand, 15 to 45 percent slopes	0.7	2.6%
MaA	Marina sand, 0 to 2 percent slopes	8.7	34.4%
MaC	Marina sand, 2 to 9 percent slopes	13.7	54.0%
MaE	Marina sand, 9 to 30 percent slopes	2.3	8.9%
Totals for Area of Interest		**25.4**	**100.0%**

GRAPHIC SCALE

250' 125' 0 250'

1"=250'

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SHEET TITLE
ULA Vulcan - VAFB SLC-3E
NRCS Soil Map

DATE
7-1-2021

FIGURE: 14

U.S. Fish and Wildlife Service
National Wetlands Inventory

VAFB SLC-3E Wetlands

March 28, 2020

Wetlands

- Estuarine and Marine Deepwater
- Estuarine and Marine Wetland
- Freshwater Emergent Wetland
- Freshwater Forested/Shrub Wetland
- Freshwater Pond
- Lake
- Other
- Riverine

This map is for general reference only. The US Fish and Wildlife Service is not responsible for the accuracy or currentness of the base data shown on this map. All wetlands related data should be used in accordance with the layer metadata found on the Wetlands Mapper web site.

National Wetlands Inventory (NWI)
This page was produced by the NWI mapper

GRAPHIC SCALE
6000' 3000' 0 6000'
1"=6000'

FIGURE: 15

DATE
7-1-2021

SHEET TITLE
ULA Vulcan - VAFB SLC-3E
Area Wetlands

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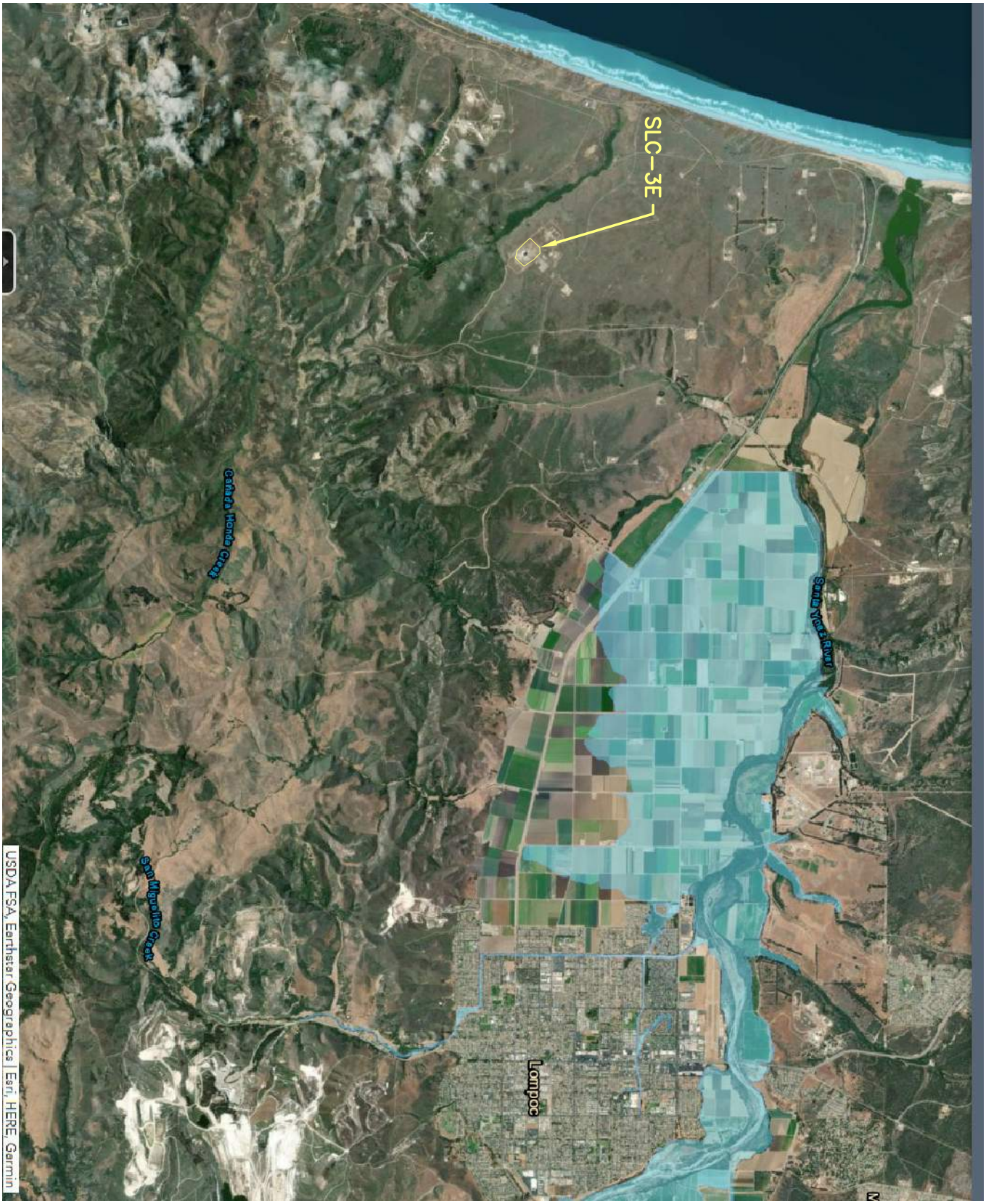

LEGEND

BLUE OVERLAY
100 YEAR ZONE

GRAPHIC SCALE

7000' 3500' 0 7000'

1"=7000'

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SHEET TITLE
ULA Vulcan - VAFB SLC-3E
Flood Zone 100 yr

DATE
7-1-2021

FIGURE: 16

APPENDIX B

Letter of Agreement

Oakland Air Route Traffic Control Center (ZOA), Los Angeles Air Route Traffic Control Center (ZLA), Santa Barbara Terminal Radar Approach Control Facility (SBA), Air Traffic Control System Command Center (ATCSCC), 30th Space Wing (30 SW)

LETTER OF AGREEMENT

EFFECTIVE: 07 APR 2020

SUBJECT: Vandenberg Space Vehicle Launch/Reentry Communications and Coordination

1. PURPOSE: This agreement establishes communication, coordination between the Federal Aviation Administration (FAA), and the 30th Space Wing (30 SW) for launch and/or reentry operations in to or through the national airspace system in accordance with 14 CFR Part 400-1199, AFI 13-201, and FAA JO 7610.4. Procedures defined in this Letter of Agreement (LOA) are part of and supplemental to all Air Force Safety requirements and agreements and are not intended to circumvent the terms or conditions of a space operator license.

2. CANCELLATION: The agreement between Western Space and Missile Center and FAA Oakland Air Route Traffic Control Center, subject "Interagency Coordination for Western Space and Missile Center Operations", is cancelled with the implementation of this agreement.

3. DISTRIBUTION: This agreement is distributed to the signatories, FAA office of Commercial Space and the Western Service Area.

4. RESPONSIBILITIES:

a. All signatories must ensure personnel operating within the scope of this agreement are knowledgeable of, understand, and comply with the provisions of this agreement.

b. 30 SW will notify ATCSCC, ZLA and ZOA of mission status at 3 hours and at 60 minutes prior to launch/deorbit burn. SBA must be notified according to this timeline when operational.

c. 30 SW will notify ATCSCC, ZLA ZOA and SBA, of any freezes or changes to launch times, or deorbit burn prior to T -30 minutes.

d. All signatories and the contracting space operator will communicate on the mission hotline, hosted by ATCSCC, no less than Target Launch Time T-30 minutes or Deorbit Burn -30 minutes. The hotline will remain active at least until the vehicle has entered earth orbit, returned to earth, completed the mission, or the mission is cancelled. The 30 SW will notify the participants to the hotline of any changes to hotline start times.

e. Deviations from responsibilities or procedures, established in this agreement must be effected only after prior coordination is accomplished, and responsibilities are clearly defined in each case.

Oakland Air Route Traffic Control Center (ZOA), Los Angeles Air Route Traffic Control Center (ZLA), Santa Barbara Terminal Radar Approach Control Facility (SBA), Air Traffic Control System Command Center (ATCSCC), 30th Space Wing (30 SW)

5. PROCEDURES:

a. 30th Space Wing must:

(1) Email the Altitude Reservation (ALTRV) request (per FAA Directives) to Central Altitude Reservation Function (CARF), no less than 12 days prior to a scheduled space operation (with cc. addresses, ZOA, ZLA, Fleet Area Control and Surveillance Facility (FACSFAC), ATCSCC Space Operations, Pacific Military Altitude Reservation Function (PACMARF), and others as appropriate.

(a) Include an operation name/number.

(b) Scheduled Primary and Backup dates/times of commencement and completion in Coordinated Universal Time (UTC).

(c) The altitudes requested.

(d) When aircraft hazard areas are contained in more than one area, the areas will be identified by name(s)/number(s)/letters.

(e) Request non-published airspace described by at least four fixes based on latitude and longitude (Degrees, Minutes).

(f) When the hazard areas fall in several Flight Information Regions (FIR), the portion CARF is responsible for will be indicated in a separate paragraph. In the event the hazard area falls within a FIR (ex. Auckland) which has an LOA with CARF, they will be included as an addressee in the message, and an additional paragraph indicating EUCARFs portion of the hazard area will be included in the message.

(2) Provide ZOA, ZLA, SBA and ATCSCC Space Ops a copy of the "Launch Airspace Safety Sheet" & "FOUO -11 Safety Sheet", at least 12 days prior to the planned launch.

(3) 30 minutes prior to launch (L-30)/or deorbit burn start (DB-30), participate on the ATC real-time hotline. Be prepared to communicate the following information:

(a) Launch status, delays or other information affecting the launch/reentry/fly-back time.

(b) Countdown status, delays or other information affecting the liftoff/deorbit burn ignition time.

(c) Verbal confirmation of critical mission events, including "Lift off" declaration.

(d) Vehicle health until the vehicle has entered earth orbit, returned to earth, touched down or otherwise completed the mission.

(4) For any unplanned events, particularly those which could produce debris, immediately advise via mission hotline which areas are affected, which are not, provide last known position and vector (if available), and provide the airspace opening times of the hazard areas if they differ from times included in the Launch Airspace Safety Sheet.

(5) Notify CARF of mission completion, cancellation, and/or the time per the Hazard Safety Sheet when the ALTRV(s) and/or Backup ALTRV(s) are no longer necessary. When CARF is closed, notify the ATCSCC National Operations Manager (NOM) 540-359-3100. Verbal notification on the hotline is preferred; however, verbal notification must be followed in writing, to include all identified areas of the ALTRV.

b. ZOA and ZLA must:

(1) Collaborate and formulate the airspace management plan and intended Notice to Airmen (NOTAMs) with ATCSCC Space Ops in advance of the space operation in accordance with JO 7400.2.

(2) Notify local facilities and other appropriate affected agencies of the proposed space operation and the pre-planned airspace mitigation strategies as required.

(3) Issue and distribute required local NOTAMs, as appropriate or required.

***NOTE** – Local NOTAMs may be issued based on CARF ALTRV approval request and may need to be modified based on revisions from CARF.*

(4) Cancel local NOTAMs when the mission is complete, cancelled, or the airspace is no longer required.

c. ATCSCC must:

(1) Share appropriate mission data including the operational impact analysis and collaborate with ATC facilities to develop the airspace management plan.

(2) Publish requested traffic management initiatives, not issued by NOTAMs, via Command Center Advisories, when necessary.

(3) Activate and host the mission hotline, no less than 30 minutes prior to the scheduled target launch time or reentry deorbit burn.

***NOTE** - Activation of the hotline could occur more than 30 minutes prior to mission, if so requested by 30SW/or Space Operator designee. Supporting air traffic facilities will not be required to be on the call until 30 minutes prior to launch time or deorbit burn.*

(4) Coordinate any additional safety or hazard mitigations relevant to the launch or reentry vehicle as needed.

d. CARF must:

(1) Upon receipt of an ALTRV, coordinate the request in accordance with current FAA Orders.

(2) Coordinate ALTRVs with foreign countries in which CARF has written agreements, for missions which depart from the U.S.

(3) Approve ALTRVs at all altitudes for the space operation. Airspace requests that lie wholly within activated SUA will not be included in the ALTRV approval.

(4) Issue the approved ALTRV to 30SW, and applicable air traffic facilities, no less than three business days prior the proposed operation.

(5) Process updates and changes per FAA Orders.

(6) Issue CARF NOTAMs for the approved ALTRV airspace.

(7) Cancel ALTRV NOTAMS upon notification from the Project Officer, Range Scheduling Representative, or designee.

6. ATTACHMENT: Contact Information

JEFF B HUBERT
Digitally signed by JEFF B HUBERT
Date: 2020.02.13 14:21:41 -08'00'

Jeff B. Hubert
Air Traffic Manager
Oakland ARTCC

LISA MARIE JONES
Digitally signed by LISA MARIE JONES
Date: 2020.02.18 17:04:02 -08'00'

Lisa Jones
Air Traffic Manager
Los Angeles ARTCC

Oakland Air Route Traffic Control Center (ZOA), Los Angeles Air Route Traffic Control Center (ZLA), Santa Barbara Terminal Radar Approach Control Facility (SBA), Air Traffic Control System Command Center (ATCSCC), 30th Space Wing (30 SW)

CARRIE L DRAPER

Digitally signed by CARRIE L DRAPER
Date: 2020.02.19 10:01:37 -08'00'

Carrie Draper
Air Traffic Manager
Santa Barbara ATC/TRACON

JENNIFER A ROSS

Digitally signed by JENNIFER A ROSS
Date: 2020.03.03 08:59:06 -05'00'

Jennifer Ross
Acting Air Traffic Manager
Air Traffic Control System Command Center

MASTALIR.ANTHONY.J.1101714930

Digitally signed by MASTALIR.ANTHONY.J.1101714930
Date: 2020.04.07 14:10:45 -07'00'

Anthony J. Mastalir
Col., USAF
Commander, 30 SW

MARK G KUCK

Digitally signed by MARK G KUCK
Date: 2020.02.19 10:29:43 -08'00'

Mark Kuck
FAA Air Traffic Representative
Western Service Center

Oakland Air Route Traffic Control Center (ZOA), Los Angeles Air Route Traffic Control Center (ZLA), Santa Barbara Terminal Radar Approach Control Facility (SBA), Air Traffic Control System Command Center (ATCSCC), 30th Space Wing (30 SW)

Attachment

Contact Information

Name/Office/Function	Email	Phone
Oakland Center Operations Manager		510 745-3331
Oakland Center MOS	9-AWP-ZOA-MOS@faa.gov	510 745-3334
Los Angeles Center MOS	9-AWP-ZLA-MOS@faa.gov	661-265-8249
Los Angeles Center Traffic Management	9-AWP-ZLA-TMU@faa.gov	661-575-2066
Los Angeles Center Operations Manager		661 265-8205
Santa Barbara TRACON (SBA)	AJT-SBA-ATM@faa.gov AJT-SBA-OS@faa.gov	805 681-0166 Recorded Line 805 681-0116
SBA Airspace Spec.		805 681-0534 ask for Airspace
30 Space Wing/2ROPS Airspace/Offshore Mgmt	2ROPS.DON@us.af.mil	805-606-0002
30 SW Scheduling Office	2ROPS.DOS@us.af.mil	805-606-8825
ATCSCC Space Operations	9-AWA-AJR-Space.Ops@faa.gov	
Central Altitude Reservation Function (CARF)	7-AWA-CARF@faa.gov	540-422-4212
Challenger Space Operations Room		540-422-4053
Launch/Reentry Hotline		540-359-3200, 2456#
National Operations Manager (NOM) (after hours, weekends and holidays)		540-359-3100 540-422-4100

APPENDIX C
Memorandum for 30 CES/ CEIE for Vulcan Centaur Program Modifications from 30 SW/SEAL

DEPARTMENT OF THE AIR FORCE

30TH SPACE WING (AFSPC)

November 2019

MEMORANDUM FOR 30 CES/CEIEA
ATTENTION:

FROM: 30 SW/SEAL
806 13th Street, Suite 319
Vandenberg AFB CA 93437-5230

SUBJECT: Vulcan Centaur Program Modifications

1. 30 CES/CEIEA has requested 30 SW/SEAL to review and comment to several questions from 30SW/JAV pertaining to the planned vehicle and site modifications to support the United Launch Alliance (ULA) Vulcan Centaur Program. Specifically requested was the 30 SW/SEAL opinion on the impacts of storing and using larger amounts of liquid hydrogen and liquid oxygen than are currently being used, and the addition of liquid natural gas (LNG) storage for first stage Vulcan booster.

2. To support ULA's upgrade for the Vulcan Centaur program, ULA will need to modify and construct greater storage capacity for liquid hydrogen and oxygen, and build new LNG storage and piping systems. 30 SW/SEAL engineers have been working this program upgrade for over two years as key design input members and recently have participated in AFSPCMAN 91-710 requirements tailoring, system requirements reviews, and various preliminary and critical design reviews for the launch vehicle and site upgrades. Through these processes, 30 SW/SEAL leverages our range specific requirements as well as ensures that the design and operations meet industry standards.

3. ULA has demonstrated their knowledge of the range requirements and implementation by using liquid hydrogen, liquid oxygen, and RP-1 (kerosene) to launch the Atlas V rocket at Space Launch Complex 3E (SLC-3E). They have extensive knowledge in the storing, transferring, vehicle tanking, and maintenance of propellant systems at SLC-3E. Through our oversight of the Atlas V program, 30 SW/SEAL has inspected and witnessed operations ULA conducts at SLC-3E. To date there have been no failures or unplanned releases of these products and ULA is highly skilled at operating these types of systems.

4. ULA currently processes cryogenic fluids, liquid hyrodren and oxygen, for the Atlas V program. The modifications to meet the new volume storage will be in compliance with range and industry standards. These requirements will ensure the vessels and piping systems will be designed, constructed, qualified, and operated similar to the existing system. The boil off rates for these cryogens due to the increase volume will require an increase in flow to the flare stack. The current flaring of hydrogen does not create any impacts and the projected increased flow for a larger hydrogen system is consider negligible. The increased volume of storage and usage does

not pose any signification additional impact to the human environment over the baseline cryogenic existing operations.

5. The Vulcan first stage will utilize LNG as the fuel and liquid oxygen as the oxidizer. LNG is a cryogenic fluid that has a low vapor pressure. ULA will have to construct a new storage facility for the use of LNG and provide flare stacks to burn LNG vapors for normal boil off from storage and propellant transfers. 30 SW/SEAL with ULA, agreed to use the National Fire Protection Association (NFPA) 59A Standard for the Production, Storage, and Handling of Liquefied Natural Gas for the Vulcan SLC-3E upgrades. This NFPA standard along with American Society of Mechanical Engineers tank and piping design requirements, will ensure the safe handling and storage of LNG. The addition of LNG flare stacks to burn and treat LNG vapors is similar to treating hydrogen vapors and does not pose a signification impact. LNG is widely used and regulated in industry, and with the range's knowledge of processing various propellants for the spacelift missions, does not pose a significant impact to the quality of the human environment.

6. It is 30 SW/SEAL opinion that the increase liquid hydrogen and oxygen, with the new storage of LNG, is in compliance with range and industry requirements for these commodities. Further, AFSPCMAN 91-710 is the culmination of lessons learned derived from processing hazardous commodities for space lift and missile systems at the ranges and is being used to guide SLC-3E flight and ground system upgrades. Also, ULA has extensive knowledge processing these or similar commodities on the range with an impeccable safety record. It is the opinion of 30 SW/SEAL that modificaitons required to support the Vulcan Centuar Program at SLC-3E pose no increase risk to the human environment than the current processes. These site and vehicle modificaitons should be considered baselined to the existing Atlas V operations.

6. For any questions, please contact me at 805-606-2286, or by e-mail at kevin.case@us.af.mil.

KEVIN R. CASE, GS-14, DAFC
Chief, Launch Vehicle System Engineering

APPENDIX D

Letter of Authorization

Letter of Authorization

The 30th Space Wing, U.S. Air Force (USAF), is hereby authorized to take marine mammals incidental to those activities at Vandenberg Air Force Base (VAFB), California, in accordance with 50 CFR 217, Subpart G--Taking Of Marine Mammals Incidental To Rocket and Missile Launches and Aircraft Operations at Vandenberg Air Force Base (VAFB), California subject to the provisions of the Marine Mammal Protection Act (16 U.S.C. 1361 *et seq.*; MMPA) and the following conditions:

1. This Letter of Authorization (LOA) is valid for five years from the date signed.

2. This Authorization is valid only for rocket, missile, and aircraft activities activities at VAFB, California.

3. General Conditions

    (a) A copy of this LOA must be in the possession of the USAF, its designees, and personnel operating under the authority of this LOA.

    (b) The species authorized for taking by incidental harassment are: Pacific harbor seals (*Phoca vitulina richardsi*); California sea lions (*Zalophus californianus)*; northern elephant seals (*Mirounga angustirostris*); northern fur seals (*Callorhinus ursinus*); Guadalupe fur seals (*Arctocephalus philippii townsendi*); and Steller sea lions (*Eumetopias jubatus*).

    (c) The taking, by Level B harassment only, is limited to the species listed in condition 3(b). See Table 1 (attached) for numbers of take authorized.

    (d) The taking by injury (Level A harassment), serious injury, or death of any of the species listed in condition 3(b) of the Authorization or any taking of any other species of marine mammal is prohibited and may result in the modification, suspension, or revocation of this LOA.

4. The following activities are authorized to take, by incidental harassment only, the species of marine mammals identified in condition 3(b) above and will take place at space launch complexes, launch facilities, and test pads on VAFB:

    (a) Launching of no more than 15 missiles annually;

    (b) Launching of no more than 110 rockets annually;

    (c) Recoveries of no more than 12 Falcon 9 rockets annually;

(d) Unmanned aerial systems (UAS) operations.

5. Mitigation Measures. Unless constrained by human safety or national security the holder of this Authorization is required to implement the following mitigation measures:

(a) Rocket launches must be scheduled to avoid launches which are predicted to produce a sonic boom on the Northern Channel Islands during the harbor seal pupping season of March through June, whenever possible.

(b) Aircraft and helicopter flight paths must maintain a minimum distance of 1,000 ft (305 m) from recognized pinniped haulouts and rookeries whenever possible, except for one area near the VAFB harbor over which aircraft may be flown to within 500 ft of a haulout, and except in emergencies or for real-time security incidents.

(c) For UAS, except during take-off and landing, the following minimum altitudes must be maintained over all known marine mammal haulouts when marine mammals are present: Class 0-2 UAS must maintain a minimum altitude of 300 feet; Class 3 UAS must maintain a minimum altitude of 500 feet; Class 4 or 5 UAS must not be flown below 1,000 feet.

(d) If any incident of injury or mortality of a marine mammal discovered during post-launch surveys or indications of affects to the distribution, size, or productivity of the affected pinniped populations as a result of the authorized activities are thought to have occurred, launch procedures and monitoring methods must be reviewed, in cooperation with NMFS, If necessary, appropriate changes must be made through modification to this Authorization prior to conducting the next launch of the same vehicle.

6. Monitoring. The holder of this Authorization is required to conduct marine mammal monitoring and to conduct acoustic monitoring as described below:

(a) The USAF must either use video recording, or, must designate a qualified on-site individual approved in advance by NMFS, with demonstrated proficiency in the identification of all age and sex classes of both common and uncommon pinniped species found at VAFB and the Northern Channel Islands and knowledge of approved count methodology and experience in observing pinniped behavior, to monitor and document pinniped activity as described in 6(b) through 6(k).

(b) For any launches of space launch vehicles or recoveries of the Falcon 9 First Stage occurring from January 1 through July 31, pinniped activity at VAFB must be monitored in the vicinity of the haulout nearest the launch platform, or, in the absence of pinnipeds at that location, at another nearby haulout, for at least 72 hours prior to any planned launch, and continue for a period of time not less than 48 hours subsequent to the launch and/or recovery.

(c) For any launches of new space launch vehicles that have not been monitored during at least three previous launches occurring from August 1 through December 31, pinniped activity at VAFB must be monitored in the vicinity of the haulout nearest the launch or landing platform, or, in the absence of pinnipeds at that location, at another nearby haulout, for at least 72 hours prior to any planned launch, and continue for a period of time not less than 48 hours subsequent to launching.

(d) For any launches of existing space launch vehicles that are expected to result in a louder launch noise or sonic boom than previous launches of the same vehicle type occurring from August 1 through December 31, pinniped activity at VAFB must be monitored in the vicinity of the haulout nearest the launch or landing platform, or, in the absence of pinnipeds at that location, at another nearby haulout, for at least 72 hours prior to any planned launch, and continue for a period of time not less than 48 hours subsequent to launching.

(e) For any launches of new types of missiles occurring from August 1 through December 31, pinniped activity at VAFB must be monitored in the vicinity of the haulout nearest the launch or landing platform, or, in the absence of pinnipeds at that location, at another nearby haulout, for at least 72 hours prior to any planned launch, and continue for a period of time not less than 48 hours subsequent to launching.

(f) For any recoveries of the Falcon 9 First Stage occurring from August 1 through December 31 that are predicted to result in a sonic boom of 1.0 pounds per square foot (psf) or above at VAFB, pinniped activity at VAFB must be monitored in the vicinity of the haulout nearest the launch or landing platform, or, in the absence of pinnipeds at that location, at another nearby haulout, for at least 72 hours prior to any planned launch, and continue for a period of time not less than 48 hours subsequent to launching.

(g) For any launches or Falcon 9 First Stage recoveries occurring from January 1 through July 31, follow-up surveys must be conducted within two weeks of the launch.

(h) For any launches or Falcon 9 First Stage recoveries, if it is determined by modeling that a sonic boom of greater than 2.0 psf is predicted to impact one of the Northern Channel Islands between March 1 and July 31, greater than 3.0 psf between August 1 and September 30, and greater than 4.0 psf between October 1 and February 28, pinniped activity at the Northern Channel Islands must be monitored. Monitoring must be conducted at the haulout site closest to the predicted sonic boom impact area, or, in the absence of pinnipeds at that location, at another nearby haulout.

(i) Marine mammal monitoring must include multiple surveys each day that record the species, number of animals, general behavior, presence of pups, age class, gender and reaction to launch noise, sonic booms or other natural or human caused disturbances, in addition to environmental conditions such as tide, wind speed, air temperature, and swell.

(j) Marine mammal monitoring of activities that occur during darkness at VAFB must include night video monitoring, when feasible.

(k) For any launches or Falcon 9 First Stage recoveries for which marine mammal monitoring is required, acoustic measurements must also be made.

7. Reporting. The holder of this Authorization is required to:

(a) Submit a report to the Office of Protected Resources, NMFS, and West Coast Regional Administrator, NMFS, within 90 days after each monitored rocket launch, missile launch or rocket recovery. This report must contain the following information:

i. Date(s) and time(s) of the launch,

ii. Design of the monitoring program, and

iii. Results of the monitoring program, including, but not necessarily limited to:

A. Numbers of pinnipeds present on the haulout prior to commencement of the launch.

B. Numbers of pinnipeds that may have been harassed, as noted by the number of pinnipeds estimated to have moved greater than two times the animal's body length, or, if the animal was already moving and changed direction and/or speed, or, if the animal flushed from land into the water in response to launch noise or sonic boom.

C. For any marine mammals that entered the water, the length of time those animals remained off the haulout.

D. Description of observed behavioral modifications by pinnipeds that were likely the result of launch noise or the sonic boom.

E. Results of acoustic monitoring, including the intensity of any sonic boom (psf) and sound levels in SELs, SPL_{peak} and SPL_{rms}.

(b) Submit a draft annual report to the Permits and Conservation Division, Office of Protected Resources, NMFS at 1315 East-West Highway, Silver Spring, MD

20910 and the Assistant Regional Administrator, West Coast Region, NMFS. This report must contain detailed information on the following:

i. Date(s) and time(s) of each missile and rocket launch and/or recovery.

ii. Design of the monitoring program;

iii. Results of the monitoring programs described under conditions 7(a)iii including the following:

A. Dates and times of all monitoring activities;

B. Details of all marine mammal sightings, including the number of pinnipeds, by species and haulout location, that remained ashore and/or fled from the beach in response to authorized activities;

C. The number of marine mammals, by species, returned to the haulout subsequent to the disruption (including estimates of the time it took for pinnipeds to return to haulouts), and estimates of the amount and nature of all instances of harassment; and

D. Information on the weather, including tidal state and horizontal visibility.

E. Date(s) and location(s) of any research activities related to monitoring the effects of launch noise and sonic booms on marine mammal populations; and

F. A summary of observed effects of UAS operations on marine mammals at VAFB.

(c) Submit a final annual report, within 60 days of receipt of any recommendations made by NMFS following review of the draft annual report by the Permits and Conservation Division, Office of Protected Resources, NMFS.

(d) Submit a draft comprehensive report to the Permits and Conservation Division, Office of Protected Resources, NMFS at 1315 East-West Highway, Silver Spring, MD 20910 and the Assistant Regional Administrator, West Coast Region, NMFS, at least 180 days prior to the expiration of the current regulations. This report must:

i. Summarize the activities undertaken and the results reported in all previous reports;

ii. Assess the impacts at each of the major rookeries;

iii. Assess the cumulative impacts on pinnipeds and other marine mammals from VAFB activities; and

iv. State the date(s), location(s), and findings of any research activities related to monitoring the effects of launch noise and sonic booms on marine mammal populations.

(e) Submit a final comprehensive report, within 60 days of receipt of any recommendations made by NMFS following review of the draft comprehensive report by the Permits and Conservation Division, Office of Protected Resources, NMFS, and the West Coast Regional Administrator, NMFS.

(f) Reporting of injured or dead marine mammals:

i. In the event that the specified activity clearly causes the take of a marine mammal in a manner not authorized by this LOA, such as serious injury or mortality, the USAF shall immediately cease the specified activities and immediately report the incident to the NMFS Office of Protected Resources ((301) 427-8401) and the NMFS West Coast regional stranding coordinator ((562) 980-3230). The report must include the following information:

A. Time, date, and location (latitude/longitude) of the incident;
B. Description of the incident;
C. Status of all sound source use in the 24 hours preceding the incident;
D. Environmental conditions (*e.g.*, wind speed and direction, cloud cover, and visibility);
E. Description of all marine mammal observations in the 24 hours preceding the incident;
F. Species identification or description of the animal(s) involved;
G. Fate of the animal(s); and
H. Photographs or video footage of the animal(s).

Activities shall not resume until NMFS is able to review the circumstances of the prohibited take. NMFS will work with the USAF to determine what measures are necessary to minimize the likelihood of further prohibited take and ensure MMPA compliance. The USAF may not resume their activities until notified by NMFS.

ii. In the event that the USAF discovers an injured or dead marine mammal, and determines that the cause of the injury or death is unknown and the death is relatively recent (*e.g.*, in less than a moderate state of decomposition), the USAF shall immediately report the incident to the NMFS Office of Protected Resources ((301) 427-8401) and the NMFS West Coast regional stranding coordinator ((562) 980-3230). The report must include the same information identified in condition 7(f)(i) of this LOA. Activities may continue while NMFS reviews the circumstances of the incident. NMFS will work with the USAF to determine whether additional mitigation measures or modifications to the activities are appropriate.

iii. In the event that the USAF discovers an injured or dead marine mammal, and determines that the injury or death is not associated with or related to the specified activities (*e.g.*, previously wounded animal, carcass with moderate to advanced decomposition, or scavenger damage), the USAF shall report the incident to the NMFS Office of Protected Resources ((301) 427-8401) and the NMFS West Coast regional stranding coordinator ((562) 980-3230), within 24 hours of the discovery. The USAF shall provide photographs, video footage or other documentation of the sighting to NMFS.

8. This Authorization may be modified, suspended or withdrawn if the USAF fails to abide by the conditions prescribed herein or if the authorized taking is having more than a negligible impact on the species or stock of affected marine mammals.

Donna S. Wieting

Donna S. Wieting, Director
Office of Protected Resources

APR 10 2019

Date

Table 1. Numbers of takes authorized annually.

Species (stock)	2019	2020	2021	2022	2023	2024
Harbor seal	19,524	22,733	27,652	35,466	43,489	16,742
California sea lion	28,187	36,019	51,307	63,805	83,385	21,756
Northern elephant seal	4,170	5,283	7,434	9,253	12,036	5,481
Steller Sea Lion	134	168	221	302	387	105
Northern fur seal	1,190	1,530	2,210	2,721	3,571	26
Guadalupe fur seal	46	59	85	104	137	36

APPENDIX E

Air Conformity Applicability Model Record of Air Analysis Summary and Detail Reports

AIR CONFORMITY APPLICABILITY MODEL REPORT
RECORD OF AIR ANALYSIS (ROAA)

1. General Information: The Air Force's Air Conformity Applicability Model (ACAM) was used to perform an analysis to assess the potential air quality impact/s associated with the action in accordance with the Air Force Manual 32-7002, Environmental Compliance and Pollution Prevention; the Environmental Impact Analysis Process (EIAP, 32 CFR 989); and the General Conformity Rule (GCR, 40 CFR 93 Subpart B). This report provides a summary of the ACAM analysis.

a. Action Location:

Base: VANDENBERG AFB
State: California
County(s): Santa Barbara
Regulatory Area(s): NOT IN A REGULATORY AREA

b. Action Title: United Launch Alliance Vulcan Centaur Program Operations and Launch from SLC-3E, VAFB

c. Project Number/s (if applicable):

d. Projected Action Start Date: 1 / 2022

e. Action Description:

The Proposed Action to support Vulcan Centaur Program operations requires minor demolition of existing structures, modifications to existing facilities and construction of new infastructure at Site B330. Modifications to the site include installing a new liquid natura gas (LNG) system; modifying the existing liquid hydrogen (LH2) and liquid oxygen (LO2) systems; augmenting the gaseous nitrogen GN2 (world purge); replacing the existing acoustic suppression water system (ASWS); modifying the SLC-3E mobile service tower (MST) and fixed launch platform (FLP); modifying the grounding system at Solid Motor Building 945; and modifying offsite roadway intersections. Construction is expected to take 18 months.

f. Point of Contact:

Name: Jeffrey Longshore
Title: Engineer
Organization: Nelson Engineering Co.
Email: j.longshore@nelsonengrco.com
Phone Number: 321-449-1128

2. Air Impact Analysis: Based on the attainment status at the action location, the requirements of the General Conformity Rule are:

_____ applicable
__X__ not applicable

Total net direct and indirect emissions associated with the action were estimated through ACAM on a calendar-year basis for the start of the action through achieving "steady state" (i.e., net gain/loss upon action fully implemented) emissions. The ACAM analysis used the latest and most accurate emission estimation techniques available; all algorithms, emission factors, and methodologies used are described in detail in the USAF Air Emissions Guide for Air Force Stationary Sources, the USAF Air Emissions Guide for Air Force Mobile Sources, and the USAF Air Emissions Guide for Air Force Transitory Sources.

"Insignificance Indicators" were used in the analysis to provide an indication of the significance of potential impacts to air quality based on current ambient air quality relative to the National Ambient Air Quality Standards (NAAQSs). These insignificance indicators are the 250 ton/yr Prevention of Significant Deterioration (PSD) major source threshold for actions occurring in areas that are "Clearly Attainment" (i.e., not within 5% of any NAAQS) and the GCR de minimis values (25 ton/yr for lead and 100 ton/yr for all other criteria pollutants) for actions

occurring in areas that are "Near Nonattainment" (i.e., within 5% of any NAAQS). These indicators do not define a significant impact; however, they do provide a threshold to identify actions that are insignificant. Any action with net emissions below the insignificance indicators for all criteria pollutant is considered so insignificant that the action will not cause or contribute to an exceedance on one or more NAAQSs. For further detail on insignificance indicators see chapter 4 of the Air Force Air Quality Environmental Impact Analysis Process (EIAP) Guide, Volume II - Advanced Assessments.

The action's net emissions for every year through achieving steady state were compared against the Insignificance Indicator and are summarized below.

Analysis Summary:

2022

Pollutant	Action Emissions (ton/yr)	INSIGNIFICANCE INDICATOR	
		Indicator (ton/yr)	Exceedance (Yes or No)
NOT IN A REGULATORY AREA			
VOC	0.775	100	No
NOx	2.880	100	No
CO	4.922	250	No
SOx	0.011	250	No
PM 10	3.388	250	No
PM 2.5	0.140	250	No
Pb	0.000	25	No
NH3	0.030	250	No
CO2e	1064.8		

2023

Pollutant	Action Emissions (ton/yr)	INSIGNIFICANCE INDICATOR	
		Indicator (ton/yr)	Exceedance (Yes or No)
NOT IN A REGULATORY AREA			
VOC	0.405	100	No
NOx	0.094	100	No
CO	1.120	250	No
SOx	0.002	250	No
PM 10	0.027	250	No
PM 2.5	0.012	250	No
Pb	0.000	25	No
NH3	0.014	250	No
CO2e	197.9		

2024 - (Steady State)

Pollutant	Action Emissions (ton/yr)	INSIGNIFICANCE INDICATOR	
		Indicator (ton/yr)	Exceedance (Yes or No)
NOT IN A REGULATORY AREA			
VOC	0.000	100	No
NOx	0.000	100	No
CO	0.000	250	No
SOx	0.000	250	No
PM 10	0.000	250	No
PM 2.5	0.000	250	No
Pb	0.000	25	No
NH3	0.000	250	No
CO2e	0.0		

AIR CONFORMITY APPLICABILITY MODEL REPORT
RECORD OF AIR ANALYSIS (ROAA)

None of estimated annual net emissions associated with this action are above the insignificance indicators, indicating no significant impact to air quality.Therefore, the action will not cause or contribute to an exceedance on one or more NAAQSs.No further air assessment is needed.

_____ _____

Jeffrey Longshore, Engineer DATE

DETAIL AIR CONFORMITY APPLICABILITY MODEL REPORT

1. General Information

- Action Location

Base: VANDENBERG AFB
State: California
County(s): Santa Barbara
Regulatory Area(s): NOT IN A REGULATORY AREA

- Action Title: United Launch Alliance Vulcan Centaur Program Operations and Launch from SLC-3E, VAFB

- Project Number/s (if applicable):

- Projected Action Start Date: 1 / 2022

- Action Purpose and Need:

The purpose of ULA's Proposed Action is to provide a versatile, cost competitive launch vehicle that meets all current USSF LSA requirements to provide medium (2,500 to 17,000 pounds) and heavy (13,500 to 41,000 pounds) payload lift capability for Government space launches at lower recurring costs than current ULA expendable systems. The ULA Vulcan Centaur maximizes use of existing space launch infrastructure, provides the USAF with additional lift capability and eliminates reliance on the current Atlas V RD-180 Russian-supplied engines.

The Vulcan Centaur Program will support the Commercial Space Launch Act and its Amendments and both manned and unmanned NASA, DoD and commercial payloads.
The Proposed Action allows continued fulfillment of the National Space Policy to actively promote the purchase and use of US commercial space goods and services and reduce space transportation costs as well as eliminating use of Russian-supplied engines. ULA believes that its launch service is needed to address the demand for cost-competitive commercial launch vehicles to ensure US space launch capability is not reduced or limited.

- Action Description:

The Proposed Action to support Vulcan Centaur Program operations requires minor demolition of existing structures, modifications to existing facilities and construction of new infastructure at Site B330. Modifications to the site include installing a new liquid natura gas (LNG) system; modifying the existing liquid hydrogen (LH2) and liquid oxygen (LO2) systems; augmenting the gaseous nitrogen GN2 (world purge); replacing the existing acoustic suppression water system (ASWS); modifying the SLC-3E mobile service tower (MST) and fixed launch platform (FLP); modifying the grounding system at Solid Motor Building 945; and modifying offsite roadway intersections. Construction is expected to take 18 months.

- Point of Contact

Name: Jeffrey Longshore
Title: Engineer
Organization: Nelson Engineering Co.
Email: j.longshore@nelsonengrco.com
Phone Number: 321-449-1128

- Activity List:

Activity Type		Activity Title
2.	Construction / Demolition	Vulcan Centaur Program, SLC-3E, VAFB, Construction and Demolition
3.	Personnel	Vulcan Centaur Program, SLC-3E, VAFB, Temporary Construction Personnel

DETAIL AIR CONFORMITY APPLICABILITY MODEL REPORT

Emission factors and air emission estimating methods come from the United States Air Force's Air Emissions Guide for Air Force Stationary Sources, Air Emissions Guide for Air Force Mobile Sources, and Air Emissions Guide for Air Force Transitory Sources.

2. Construction / Demolition

2.1 General Information & Timeline Assumptions

- Activity Location
County: Santa Barbara
Regulatory Area(s): NOT IN A REGULATORY AREA

- Activity Title: Vulcan Centaur Program, SLC-3E, VAFB, Construction and Demolition

- Activity Description:
Construction and demolition activities for onsite (SLC-3E) and offsite will all occur within Vandenberg Air Force Base property as described in Section 2.1 of the SEA.

- Activity Start Date
Start Month: 1
Start Month: 2022

- Activity End Date
Indefinite: False
End Month: 12
End Month: 2023

- Activity Emissions:

Pollutant	Total Emissions (TONs)
VOC	0.661280
SO_x	0.006886
NO_x	2.692388
CO	2.681281
PM 10	3.334251

Pollutant	Total Emissions (TONs)
PM 2.5	0.116663
Pb	0.000000
NH_3	0.002355
CO_2e	669.0

2.1 Demolition Phase

2.1.1 Demolition Phase Timeline Assumptions

- Phase Start Date
Start Month: 1
Start Quarter: 1
Start Year: 2022

- Phase Duration
Number of Month: 3
Number of Days: 0

2.1.2 Demolition Phase Assumptions

- General Demolition Information
Area of Building to be demolished (ft^2): 2000
Height of Building to be demolished (ft): 260

DETAIL AIR CONFORMITY APPLICABILITY MODEL REPORT

- Default Settings Used: Yes

- Average Day(s) worked per week: 5 (default)

- Construction Exhaust (default)

Equipment Name	Number Of Equipment	Hours Per Day
Concrete/Industrial Saws Composite	1	8
Rubber Tired Dozers Composite	1	1
Tractors/Loaders/Backhoes Composite	2	6

- Vehicle Exhaust

Average Hauling Truck Capacity (yd^3): 20 (default)
Average Hauling Truck Round Trip Commute (mile): 20 (default)

- Vehicle Exhaust Vehicle Mixture (%)

	LDGV	LDGT	HDGV	LDDV	LDDT	HDDV	MC
POVs	0	0	0	0	0	100.00	0

- Worker Trips

Average Worker Round Trip Commute (mile): 20 (default)

- Worker Trips Vehicle Mixture (%)

	LDGV	LDGT	HDGV	LDDV	LDDT	HDDV	MC
POVs	50.00	50.00	0	0	0	0	0

2.1.3 Demolition Phase Emission Factor(s)

- Construction Exhaust Emission Factors (lb/hour) (default)

Concrete/Industrial Saws Composite								
	VOC	**SO_x**	**NO_x**	**CO**	**PM 10**	**PM 2.5**	**CH_4**	**CO_2e**
Emission Factors	0.0410	0.0006	0.2961	0.3743	0.0148	0.0148	0.0037	58.556
Rubber Tired Dozers Composite								
	VOC	**SO_x**	**NO_x**	**CO**	**PM 10**	**PM 2.5**	**CH_4**	**CO_2e**
Emission Factors	0.1919	0.0024	1.3611	0.7352	0.0536	0.0536	0.0173	239.51
Tractors/Loaders/Backhoes Composite								
	VOC	**SO_x**	**NO_x**	**CO**	**PM 10**	**PM 2.5**	**CH_4**	**CO_2e**
Emission Factors	0.0383	0.0007	0.2301	0.3598	0.0095	0.0095	0.0034	66.884

- Vehicle Exhaust & Worker Trips Emission Factors (grams/mile)

	VOC	SO_x	NO_x	CO	PM 10	PM 2.5	Pb	NH_3	CO_2e
LDGV	000.114	000.003	000.084	000.992	000.047	000.020		000.023	00298.845
LDGT	000.288	000.004	000.178	001.871	000.048	000.021		000.024	00379.038
HDGV	000.600	000.011	001.339	008.875	000.183	000.078		000.045	01128.468
LDDV	000.026	000.003	000.125	000.281	000.060	000.032		000.008	00271.718
LDDT	000.094	000.003	000.533	000.594	000.112	000.082		000.008	00364.857
HDDV	000.194	000.014	004.796	001.133	000.211	000.117		000.028	01514.699
MC	004.452	000.002	001.252	023.791	000.019	000.009		000.054	00187.891

2.1.4 Demolition Phase Formula(s)

- Fugitive Dust Emissions per Phase
$PM10_{FD}$ = (0.00042 * BA * BH) / 2000

$PM10_{FD}$: Fugitive Dust PM 10 Emissions (TONs)
0.00042: Emission Factor (lb/ft^3)
BA: Area of Building to be demolished (ft^2)
BH: Height of Building to be demolished (ft)
2000: Conversion Factor pounds to tons

- Construction Exhaust Emissions per Phase
CEE_{POL} = (NE * WD * H * EF_{POL}) / 2000

CEE_{POL}: Construction Exhaust Emissions (TONs)
NE: Number of Equipment
WD: Number of Total Work Days (days)
H: Hours Worked per Day (hours)
EF_{POL}: Emission Factor for Pollutant (lb/hour)
2000: Conversion Factor pounds to tons

- Vehicle Exhaust Emissions per Phase
VMT_{VE} = BA * BH * (1 / 27) * 0.25 * (1 / HC) * HT

VMT_{VE}: Vehicle Exhaust Vehicle Miles Travel (miles)
BA: Area of Building being demolish (ft^2)
BH: Height of Building being demolish (ft)
(1 / 27): Conversion Factor cubic feet to cubic yards (1 yd^3 / 27 ft^3)
0.25: Volume reduction factor (material reduced by 75% to account for air space)
HC: Average Hauling Truck Capacity (yd^3)
(1 / HC): Conversion Factor cubic yards to trips (1 trip / HC yd^3)
HT: Average Hauling Truck Round Trip Commute (mile/trip)

V_{POL} = (VMT_{VE} * 0.002205 * EF_{POL} * VM) / 2000

V_{POL}: Vehicle Emissions (TONs)
VMT_{VE}: Vehicle Exhaust Vehicle Miles Travel (miles)
0.002205: Conversion Factor grams to pounds
EF_{POL}: Emission Factor for Pollutant (grams/mile)
VM: Vehicle Exhaust On Road Vehicle Mixture (%)
2000: Conversion Factor pounds to tons

- Worker Trips Emissions per Phase
VMT_{WT} = WD * WT * 1.25 * NE

VMT_{WT}: Worker Trips Vehicle Miles Travel (miles)
WD: Number of Total Work Days (days)
WT: Average Worker Round Trip Commute (mile)
1.25: Conversion Factor Number of Construction Equipment to Number of Works
NE: Number of Construction Equipment

$V_{POL} = (VMT_{WT} * 0.002205 * EF_{POL} * VM) / 2000$

V_{POL}: Vehicle Emissions (TONs)
VMT_{WT}: Worker Trips Vehicle Miles Travel (miles)
0.002205: Conversion Factor grams to pounds
EF_{POL}: Emission Factor for Pollutant (grams/mile)
VM: Worker Trips On Road Vehicle Mixture (%)
2000: Conversion Factor pounds to tons

2.2 Site Grading Phase

2.2.1 Site Grading Phase Timeline Assumptions

- Phase Start Date
Start Month: 1
Start Quarter: 1
Start Year: 2022

- Phase Duration
Number of Month: 2
Number of Days: 0

2.2.2 Site Grading Phase Assumptions

- General Site Grading Information
Area of Site to be Graded (ft^2): 150000
Amount of Material to be Hauled On-Site (yd^3): 1000
Amount of Material to be Hauled Off-Site (yd^3): 100

- Site Grading Default Settings
Default Settings Used: Yes
Average Day(s) worked per week: 5 (default)

- Construction Exhaust (default)

Equipment Name	Number Of Equipment	Hours Per Day
Excavators Composite	1	8
Graders Composite	1	8
Other Construction Equipment Composite	1	8
Rubber Tired Dozers Composite	1	8
Scrapers Composite	3	8
Tractors/Loaders/Backhoes Composite	2	7

- Vehicle Exhaust
Average Hauling Truck Capacity (yd^3): 20 (default)
Average Hauling Truck Round Trip Commute (mile): 20 (default)

- Vehicle Exhaust Vehicle Mixture (%)

	LDGV	LDGT	HDGV	LDDV	LDDT	HDDV	MC
POVs	0	0	0	0	0	100.00	0

- Worker Trips
Average Worker Round Trip Commute (mile): 20 (default)

- Worker Trips Vehicle Mixture (%)

	LDGV	LDGT	HDGV	LDDV	LDDT	HDDV	MC
POVs	50.00	50.00	0	0	0	0	0

2.2.3 Site Grading Phase Emission Factor(s)

- Construction Exhaust Emission Factors (lb/hour) (default)

Excavators Composite								
	VOC	**SO_x**	**NO_x**	**CO**	**PM 10**	**PM 2.5**	**CH_4**	**CO_2e**
Emission Factors	0.0648	0.0013	0.3170	0.5103	0.0136	0.0136	0.0058	119.72
Graders Composite								
	VOC	**SO_x**	**NO_x**	**CO**	**PM 10**	**PM 2.5**	**CH_4**	**CO_2e**
Emission Factors	0.0806	0.0014	0.4657	0.5731	0.0217	0.0217	0.0072	132.92
Other Construction Equipment Composite								
	VOC	**SO_x**	**NO_x**	**CO**	**PM 10**	**PM 2.5**	**CH_4**	**CO_2e**
Emission Factors	0.0507	0.0012	0.2785	0.3488	0.0105	0.0105	0.0045	122.61
Rubber Tired Dozers Composite								
	VOC	**SO_x**	**NO_x**	**CO**	**PM 10**	**PM 2.5**	**CH_4**	**CO_2e**
Emission Factors	0.1919	0.0024	1.3611	0.7352	0.0536	0.0536	0.0173	239.51
Scrapers Composite								
	VOC	**SO_x**	**NO_x**	**CO**	**PM 10**	**PM 2.5**	**CH_4**	**CO_2e**
Emission Factors	0.1723	0.0026	1.1176	0.7579	0.0447	0.0447	0.0155	262.87
Tractors/Loaders/Backhoes Composite								
	VOC	**SO_x**	**NO_x**	**CO**	**PM 10**	**PM 2.5**	**CH_4**	**CO_2e**
Emission Factors	0.0383	0.0007	0.2301	0.3598	0.0095	0.0095	0.0034	66.884

- Vehicle Exhaust & Worker Trips Emission Factors (grams/mile)

	VOC	SO_x	NO_x	CO	PM 10	PM 2.5	Pb	NH_3	CO_2e
LDGV	000.114	000.003	000.084	000.992	000.047	000.020		000.023	00298.845
LDGT	000.288	000.004	000.178	001.871	000.048	000.021		000.024	00379.038
HDGV	000.600	000.011	001.339	008.875	000.183	000.078		000.045	01128.468
LDDV	000.026	000.003	000.125	000.281	000.060	000.032		000.008	00271.718
LDDT	000.094	000.003	000.533	000.594	000.112	000.082		000.008	00364.857
HDDV	000.194	000.014	004.796	001.133	000.211	000.117		000.028	01514.699
MC	004.452	000.002	001.252	023.791	000.019	000.009		000.054	00187.891

2.2.4 Site Grading Phase Formula(s)

- Fugitive Dust Emissions per Phase

$PM10_{FD} = (20 * ACRE * WD) / 2000$

$PM10_{FD}$: Fugitive Dust PM 10 Emissions (TONs)
20: Conversion Factor Acre Day to pounds (20 lb / 1 Acre Day)
ACRE: Total acres (acres)
WD: Number of Total Work Days (days)
2000: Conversion Factor pounds to tons

DETAIL AIR CONFORMITY APPLICABILITY MODEL REPORT

- Construction Exhaust Emissions per Phase
$CEE_{POL} = (NE * WD * H * EF_{POL}) / 2000$

CEE_{POL}: Construction Exhaust Emissions (TONs)
NE: Number of Equipment
WD: Number of Total Work Days (days)
H: Hours Worked per Day (hours)
EF_{POL}: Emission Factor for Pollutant (lb/hour)
2000: Conversion Factor pounds to tons

- Vehicle Exhaust Emissions per Phase
$VMT_{VE} = (HA_{OnSite} + HA_{OffSite}) * (1 / HC) * HT$

VMT_{VE}: Vehicle Exhaust Vehicle Miles Travel (miles)
HA_{OnSite}: Amount of Material to be Hauled On-Site (yd^3)
$HA_{OffSite}$: Amount of Material to be Hauled Off-Site (yd^3)
HC: Average Hauling Truck Capacity (yd^3)
(1 / HC): Conversion Factor cubic yards to trips (1 trip / HC yd^3)
HT: Average Hauling Truck Round Trip Commute (mile/trip)

$V_{POL} = (VMT_{VE} * 0.002205 * EF_{POL} * VM) / 2000$

V_{POL}: Vehicle Emissions (TONs)
VMT_{VE}: Vehicle Exhaust Vehicle Miles Travel (miles)
0.002205: Conversion Factor grams to pounds
EF_{POL}: Emission Factor for Pollutant (grams/mile)
VM: Vehicle Exhaust On Road Vehicle Mixture (%)
2000: Conversion Factor pounds to tons

- Worker Trips Emissions per Phase
$VMT_{WT} = WD * WT * 1.25 * NE$

VMT_{WT}: Worker Trips Vehicle Miles Travel (miles)
WD: Number of Total Work Days (days)
WT: Average Worker Round Trip Commute (mile)
1.25: Conversion Factor Number of Construction Equipment to Number of Works
NE: Number of Construction Equipment

$V_{POL} = (VMT_{WT} * 0.002205 * EF_{POL} * VM) / 2000$

V_{POL}: Vehicle Emissions (TONs)
VMT_{WT}: Worker Trips Vehicle Miles Travel (miles)
0.002205: Conversion Factor grams to pounds
EF_{POL}: Emission Factor for Pollutant (grams/mile)
VM: Worker Trips On Road Vehicle Mixture (%)
2000: Conversion Factor pounds to tons

2.3 Trenching/Excavating Phase

2.3.1 Trenching / Excavating Phase Timeline Assumptions

- Phase Start Date
Start Month: 2
Start Quarter: 1
Start Year: 2022

- Phase Duration
Number of Month: 1
Number of Days: 0

2.3.2 Trenching / Excavating Phase Assumptions

- General Trenching/Excavating Information
Area of Site to be Trenched/Excavated (ft^2): 12000
Amount of Material to be Hauled On-Site (yd^3): 100
Amount of Material to be Hauled Off-Site (yd^3): 0

- Trenching Default Settings
Default Settings Used: Yes
Average Day(s) worked per week: 5 (default)

- Construction Exhaust (default)

Equipment Name	Number Of Equipment	Hours Per Day
Excavators Composite	2	8
Other General Industrial Equipmen Composite	1	8
Tractors/Loaders/Backhoes Composite	1	8

- Vehicle Exhaust
Average Hauling Truck Capacity (yd^3): 20 (default)
Average Hauling Truck Round Trip Commute (mile): 20 (default)

- Vehicle Exhaust Vehicle Mixture (%)

	LDGV	LDGT	HDGV	LDDV	LDDT	HDDV	MC
POVs	0	0	0	0	0	100.00	0

- Worker Trips
Average Worker Round Trip Commute (mile): 20 (default)

- Worker Trips Vehicle Mixture (%)

	LDGV	LDGT	HDGV	LDDV	LDDT	HDDV	MC
POVs	50.00	50.00	0	0	0	0	0

2.3.3 Trenching / Excavating Phase Emission Factor(s)

- Construction Exhaust Emission Factors (lb/hour) (default)

Excavators Composite								
	VOC	**SO_x**	**NO_x**	**CO**	**PM 10**	**PM 2.5**	**CH_4**	**CO_2e**
Emission Factors	0.0648	0.0013	0.3170	0.5103	0.0136	0.0136	0.0058	119.72
Graders Composite								
	VOC	**SO_x**	**NO_x**	**CO**	**PM 10**	**PM 2.5**	**CH_4**	**CO_2e**
Emission Factors	0.0806	0.0014	0.4657	0.5731	0.0217	0.0217	0.0072	132.92
Other Construction Equipment Composite								
	VOC	**SO_x**	**NO_x**	**CO**	**PM 10**	**PM 2.5**	**CH_4**	**CO_2e**
Emission Factors	0.0507	0.0012	0.2785	0.3488	0.0105	0.0105	0.0045	122.61
Rubber Tired Dozers Composite								
	VOC	**SO_x**	**NO_x**	**CO**	**PM 10**	**PM 2.5**	**CH_4**	**CO_2e**
Emission Factors	0.1919	0.0024	1.3611	0.7352	0.0536	0.0536	0.0173	239.51
Scrapers Composite								
	VOC	**SO_x**	**NO_x**	**CO**	**PM 10**	**PM 2.5**	**CH_4**	**CO_2e**
Emission Factors	0.1723	0.0026	1.1176	0.7579	0.0447	0.0447	0.0155	262.87
Tractors/Loaders/Backhoes Composite								
	VOC	**SO_x**	**NO_x**	**CO**	**PM 10**	**PM 2.5**	**CH_4**	**CO_2e**
Emission Factors	0.0383	0.0007	0.2301	0.3598	0.0095	0.0095	0.0034	66.884

- Vehicle Exhaust & Worker Trips Emission Factors (grams/mile)

	VOC	**SO_x**	**NO_x**	**CO**	**PM 10**	**PM 2.5**	**Pb**	**NH_3**	**CO_2e**
LDGV	000.114	000.003	000.084	000.992	000.047	000.020		000.023	00298.845
LDGT	000.288	000.004	000.178	001.871	000.048	000.021		000.024	00379.038
HDGV	000.600	000.011	001.339	008.875	000.183	000.078		000.045	01128.468
LDDV	000.026	000.003	000.125	000.281	000.060	000.032		000.008	00271.718
LDDT	000.094	000.003	000.533	000.594	000.112	000.082		000.008	00364.857
HDDV	000.194	000.014	004.796	001.133	000.211	000.117		000.028	01514.699
MC	004.452	000.002	001.252	023.791	000.019	000.009		000.054	00187.891

2.3.4 Trenching / Excavating Phase Formula(s)

- Fugitive Dust Emissions per Phase

$PM10_{FD} = (20 * ACRE * WD) / 2000$

$PM10_{FD}$: Fugitive Dust PM 10 Emissions (TONs)
20: Conversion Factor Acre Day to pounds (20 lb / 1 Acre Day)
ACRE: Total acres (acres)
WD: Number of Total Work Days (days)
2000: Conversion Factor pounds to tons

- Construction Exhaust Emissions per Phase

$CEE_{POL} = (NE * WD * H * EF_{POL}) / 2000$

CEE_{POL}: Construction Exhaust Emissions (TONs)
NE: Number of Equipment
WD: Number of Total Work Days (days)
H: Hours Worked per Day (hours)
EF_{POL}: Emission Factor for Pollutant (lb/hour)
2000: Conversion Factor pounds to tons

- Vehicle Exhaust Emissions per Phase

$VMT_{VE} = (HA_{OnSite} + HA_{OffSite}) * (1 / HC) * HT$

VMT_{VE}: Vehicle Exhaust Vehicle Miles Travel (miles)
HA_{OnSite}: Amount of Material to be Hauled On-Site (yd^3)
$HA_{OffSite}$: Amount of Material to be Hauled Off-Site (yd^3)
HC: Average Hauling Truck Capacity (yd^3)
(1 / HC): Conversion Factor cubic yards to trips (1 trip / HC yd^3)
HT: Average Hauling Truck Round Trip Commute (mile/trip)

$V_{POL} = (VMT_{VE} * 0.002205 * EF_{POL} * VM) / 2000$

V_{POL}: Vehicle Emissions (TONs)
VMT_{VE}: Vehicle Exhaust Vehicle Miles Travel (miles)
0.002205: Conversion Factor grams to pounds
EF_{POL}: Emission Factor for Pollutant (grams/mile)
VM: Vehicle Exhaust On Road Vehicle Mixture (%)
2000: Conversion Factor pounds to tons

- Worker Trips Emissions per Phase

$VMT_{WT} = WD * WT * 1.25 * NE$

VMT_{WT}: Worker Trips Vehicle Miles Travel (miles)
WD: Number of Total Work Days (days)
WT: Average Worker Round Trip Commute (mile)
1.25: Conversion Factor Number of Construction Equipment to Number of Works
NE: Number of Construction Equipment

$V_{POL} = (VMT_{WT} * 0.002205 * EF_{POL} * VM) / 2000$

V_{POL}: Vehicle Emissions (TONs)
VMT_{VE}: Worker Trips Vehicle Miles Travel (miles)
0.002205: Conversion Factor grams to pounds
EF_{POL}: Emission Factor for Pollutant (grams/mile)
VM: Worker Trips On Road Vehicle Mixture (%)
2000: Conversion Factor pounds to tons

2.4 Building Construction Phase

2.4.1 Building Construction Phase Timeline Assumptions

- Phase Start Date

Start Month: 7
Start Quarter: 1
Start Year: 2022

- Phase Duration

Number of Month: 6
Number of Days: 0

2.4.2 Building Construction Phase Assumptions

- General Building Construction Information

Building Category: Office or Industrial
Area of Building (ft^2): 5000
Height of Building (ft): 260
Number of Units: N/A

- Building Construction Default Settings

Default Settings Used: Yes
Average Day(s) worked per week: 5 (default)

- Construction Exhaust (default)

Equipment Name	Number Of Equipment	Hours Per Day
Cranes Composite	1	4
Forklifts Composite	2	6
Generator Sets Composite	1	8
Tractors/Loaders/Backhoes Composite	1	8
Welders Composite	3	8

- Vehicle Exhaust

Average Hauling Truck Round Trip Commute (mile): 20 (default)

- Vehicle Exhaust Vehicle Mixture (%)

	LDGV	LDGT	HDGV	LDDV	LDDT	HDDV	MC
POVs	0	0	0	0	0	100.00	0

- Worker Trips

Average Worker Round Trip Commute (mile): 20 (default)

- Worker Trips Vehicle Mixture (%)

	LDGV	LDGT	HDGV	LDDV	LDDT	HDDV	MC
POVs	50.00	50.00	0	0	0	0	0

- Vendor Trips

Average Vendor Round Trip Commute (mile): 40 (default)

- Vendor Trips Vehicle Mixture (%)

	LDGV	LDGT	HDGV	LDDV	LDDT	HDDV	MC
POVs	0	0	0	0	0	100.00	0

2.4.3 Building Construction Phase Emission Factor(s)

- Construction Exhaust Emission Factors (lb/hour) (default)

Cranes Composite								
	VOC	**SO_x**	**NO_x**	**CO**	**PM 10**	**PM 2.5**	**CH_4**	**CO_2e**
Emission Factors	0.0797	0.0013	0.5505	0.3821	0.0203	0.0203	0.0071	128.81
Forklifts Composite								
	VOC	**SO_x**	**NO_x**	**CO**	**PM 10**	**PM 2.5**	**CH_4**	**CO_2e**
Emission Factors	0.0274	0.0006	0.1265	0.2146	0.0043	0.0043	0.0024	54.457
Generator Sets Composite								
	VOC	**SO_x**	**NO_x**	**CO**	**PM 10**	**PM 2.5**	**CH_4**	**CO_2e**
Emission Factors	0.0340	0.0006	0.2783	0.2694	0.0116	0.0116	0.0030	61.069

Tractors/Loaders/Backhoes Composite								
	VOC	SO_x	NO_x	CO	PM 10	PM 2.5	CH_4	CO_2e
Emission Factors	0.0383	0.0007	0.2301	0.3598	0.0095	0.0095	0.0034	66.884
Welders Composite								
	VOC	SO_x	NO_x	CO	PM 10	PM 2.5	CH_4	CO_2e
Emission Factors	0.0260	0.0003	0.1557	0.1772	0.0077	0.0077	0.0023	25.661

- Vehicle Exhaust & Worker Trips Emission Factors (grams/mile)

	VOC	SO_x	NO_x	CO	PM 10	PM 2.5	Pb	NH_3	CO_2e
LDGV	000.114	000.003	000.084	000.992	000.047	000.020		000.023	00298.845
LDGT	000.288	000.004	000.178	001.871	000.048	000.021		000.024	00379.038
HDGV	000.600	000.011	001.339	008.875	000.183	000.078		000.045	01128.468
LDDV	000.026	000.003	000.125	000.281	000.060	000.032		000.008	00271.718
LDDT	000.094	000.003	000.533	000.594	000.112	000.082		000.008	00364.857
HDDV	000.194	000.014	004.796	001.133	000.211	000.117		000.028	01514.699
MC	004.452	000.002	001.252	023.791	000.019	000.009		000.054	00187.891

2.4.4 Building Construction Phase Formula(s)

- Construction Exhaust Emissions per Phase

$CEE_{POL} = (NE * WD * H * EF_{POL}) / 2000$

CEE_{POL}: Construction Exhaust Emissions (TONs)
NE: Number of Equipment
WD: Number of Total Work Days (days)
H: Hours Worked per Day (hours)
EF_{POL}: Emission Factor for Pollutant (lb/hour)
2000: Conversion Factor pounds to tons

- Vehicle Exhaust Emissions per Phase

$VMT_{VE} = BA * BH * (0.42 / 1000) * HT$

VMT_{VE}: Vehicle Exhaust Vehicle Miles Travel (miles)
BA: Area of Building (ft^2)
BH: Height of Building (ft)
(0.42 / 1000): Conversion Factor ft^3 to trips (0.42 trip / 1000 ft^3)
HT: Average Hauling Truck Round Trip Commute (mile/trip)

$V_{POL} = (VMT_{VE} * 0.002205 * EF_{POL} * VM) / 2000$

V_{POL}: Vehicle Emissions (TONs)
VMT_{VE}: Vehicle Exhaust Vehicle Miles Travel (miles)
0.002205: Conversion Factor grams to pounds
EF_{POL}: Emission Factor for Pollutant (grams/mile)
VM: Worker Trips On Road Vehicle Mixture (%)
2000: Conversion Factor pounds to tons

- Worker Trips Emissions per Phase

$VMT_{WT} = WD * WT * 1.25 * NE$

VMT_{WT}: Worker Trips Vehicle Miles Travel (miles)
WD: Number of Total Work Days (days)
WT: Average Worker Round Trip Commute (mile)
1.25: Conversion Factor Number of Construction Equipment to Number of Works
NE: Number of Construction Equipment

$V_{POL} = (VMT_{WT} * 0.002205 * EF_{POL} * VM) / 2000$

V_{POL}: Vehicle Emissions (TONs)
VMT_{WT}: Worker Trips Vehicle Miles Travel (miles)
0.002205: Conversion Factor grams to pounds
EF_{POL}: Emission Factor for Pollutant (grams/mile)
VM: Worker Trips On Road Vehicle Mixture (%)
2000: Conversion Factor pounds to tons

- Vender Trips Emissions per Phase
$VMT_{VT} = BA * BH * (0.38 / 1000) * HT$

VMT_{VT}: Vender Trips Vehicle Miles Travel (miles)
BA: Area of Building (ft^2)
BH: Height of Building (ft)
(0.38 / 1000): Conversion Factor ft^3 to trips (0.38 trip / 1000 ft^3)
HT: Average Hauling Truck Round Trip Commute (mile/trip)

$V_{POL} = (VMT_{VT} * 0.002205 * EF_{POL} * VM) / 2000$

V_{POL}: Vehicle Emissions (TONs)
VMT_{VT}: Vender Trips Vehicle Miles Travel (miles)
0.002205: Conversion Factor grams to pounds
EF_{POL}: Emission Factor for Pollutant (grams/mile)
VM: Worker Trips On Road Vehicle Mixture (%)
2000: Conversion Factor pounds to tons

2.5 Architectural Coatings Phase

2.5.1 Architectural Coatings Phase Timeline Assumptions

- Phase Start Date
Start Month: 12
Start Quarter: 1
Start Year: 2023

- Phase Duration
Number of Month: 1
Number of Days: 0

2.5.2 Architectural Coatings Phase Assumptions

- General Architectural Coatings Information
Building Category: Non-Residential
Total Square Footage (ft^2): 20000
Number of Units: N/A

- Architectural Coatings Default Settings
Default Settings Used: Yes
Average Day(s) worked per week: 5 (default)

- Worker Trips
Average Worker Round Trip Commute (mile): 20 (default)

- Worker Trips Vehicle Mixture (%)

	LDGV	LDGT	HDGV	LDDV	LDDT	HDDV	MC
POVs	50.00	50.00	0	0	0	0	0

2.5.3 Architectural Coatings Phase Emission Factor(s)

- Worker Trips Emission Factors (grams/mile)

	VOC	SO_x	NO_x	CO	PM 10	PM 2.5	Pb	NH_3	CO_2e
LDGV	000.114	000.003	000.084	000.992	000.047	000.020		000.023	00298.845
LDGT	000.288	000.004	000.178	001.871	000.048	000.021		000.024	00379.038
HDGV	000.600	000.011	001.339	008.875	000.183	000.078		000.045	01128.468
LDDV	000.026	000.003	000.125	000.281	000.060	000.032		000.008	00271.718
LDDT	000.094	000.003	000.533	000.594	000.112	000.082		000.008	00364.857
HDDV	000.194	000.014	004.796	001.133	000.211	000.117		000.028	01514.699
MC	004.452	000.002	001.252	023.791	000.019	000.009		000.054	00187.891

2.5.4 Architectural Coatings Phase Formula(s)

- Worker Trips Emissions per Phase

$VMT_{WT} = (1 * WT * PA) / 800$

VMT_{WT}: Worker Trips Vehicle Miles Travel (miles)
1: Conversion Factor man days to trips (1 trip / 1 man * day)
WT: Average Worker Round Trip Commute (mile)
PA: Paint Area (ft^2)
800: Conversion Factor square feet to man days (1 ft^2 / 1 man * day)

$V_{POL} = (VMT_{WT} * 0.002205 * EF_{POL} * VM) / 2000$

V_{POL}: Vehicle Emissions (TONs)
VMT_{WT}: Worker Trips Vehicle Miles Travel (miles)
0.002205: Conversion Factor grams to pounds
EF_{POL}: Emission Factor for Pollutant (grams/mile)
VM: Worker Trips On Road Vehicle Mixture (%)
2000: Conversion Factor pounds to tons

- Off-Gassing Emissions per Phase

$VOC_{AC} = (AB * 2.0 * 0.0116) / 2000.0$

VOC_{AC}: Architectural Coating VOC Emissions (TONs)
BA: Area of Building (ft^2)
2.0: Conversion Factor total area to coated area (2.0 ft^2 coated area / total area)
0.0116: Emission Factor (lb/ft^2)
2000: Conversion Factor pounds to tons

2.6 Paving Phase

2.6.1 Paving Phase Timeline Assumptions

- Phase Start Date

Start Month: 7
Start Quarter: 1
Start Year: 2022

DETAIL AIR CONFORMITY APPLICABILITY MODEL REPORT

- Phase Duration
Number of Month: 3
Number of Days: 0

2.6.2 Paving Phase Assumptions

- General Paving Information
Paving Area (ft^2): 140000

- Paving Default Settings
Default Settings Used: Yes
Average Day(s) worked per week: 5 (default)

- Construction Exhaust (default)

Equipment Name	Number Of Equipment	Hours Per Day
Cement and Mortar Mixers Composite	4	6
Pavers Composite	1	7
Paving Equipment Composite	2	6
Rollers Composite	1	7

- Vehicle Exhaust
Average Hauling Truck Round Trip Commute (mile): 20 (default)

- Vehicle Exhaust Vehicle Mixture (%)

	LDGV	LDGT	HDGV	LDDV	LDDT	HDDV	MC
POVs	0	0	0	0	0	100.00	0

- Worker Trips
Average Worker Round Trip Commute (mile): 20 (default)

- Worker Trips Vehicle Mixture (%)

	LDGV	LDGT	HDGV	LDDV	LDDT	HDDV	MC
POVs	50.00	50.00	0	0	0	0	0

2.6.3 Paving Phase Emission Factor(s)

- Construction Exhaust Emission Factors (lb/hour) (default)

Excavators Composite								
	VOC	**SO_x**	**NO_x**	**CO**	**PM 10**	**PM 2.5**	**CH_4**	**CO_2e**
Emission Factors	0.0648	0.0013	0.3170	0.5103	0.0136	0.0136	0.0058	119.72
Graders Composite								
	VOC	**SO_x**	**NO_x**	**CO**	**PM 10**	**PM 2.5**	**CH_4**	**CO_2e**
Emission Factors	0.0806	0.0014	0.4657	0.5731	0.0217	0.0217	0.0072	132.92
Other Construction Equipment Composite								
	VOC	**SO_x**	**NO_x**	**CO**	**PM 10**	**PM 2.5**	**CH_4**	**CO_2e**
Emission Factors	0.0507	0.0012	0.2785	0.3488	0.0105	0.0105	0.0045	122.61
Rubber Tired Dozers Composite								
	VOC	**SO_x**	**NO_x**	**CO**	**PM 10**	**PM 2.5**	**CH_4**	**CO_2e**
Emission Factors	0.1919	0.0024	1.3611	0.7352	0.0536	0.0536	0.0173	239.51
Scrapers Composite								
	VOC	**SO_x**	**NO_x**	**CO**	**PM 10**	**PM 2.5**	**CH_4**	**CO_2e**
Emission Factors	0.1723	0.0026	1.1176	0.7579	0.0447	0.0447	0.0155	262.87
Tractors/Loaders/Backhoes Composite								

	VOC	SO_x	NO_x	CO	PM 10	PM 2.5	CH_4	CO_2e
Emission Factors	0.0383	0.0007	0.2301	0.3598	0.0095	0.0095	0.0034	66.884

- Vehicle Exhaust & Worker Trips Emission Factors (grams/mile)

	VOC	SO_x	NO_x	CO	PM 10	PM 2.5	Pb	NH_3	CO_2e
LDGV	000.114	000.003	000.084	000.992	000.047	000.020		000.023	00298.845
LDGT	000.288	000.004	000.178	001.871	000.048	000.021		000.024	00379.038
HDGV	000.600	000.011	001.339	008.875	000.183	000.078		000.045	01128.468
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HDDV	000.194	000.014	004.796	001.133	000.211	000.117		000.028	01514.699
MC	004.452	000.002	001.252	023.791	000.019	000.009		000.054	00187.891

2.6.4 Paving Phase Formula(s)

- Construction Exhaust Emissions per Phase

$CEE_{POL} = (NE * WD * H * EF_{POL}) / 2000$

CEE_{POL}: Construction Exhaust Emissions (TONs)
NE: Number of Equipment
WD: Number of Total Work Days (days)
H: Hours Worked per Day (hours)
EF_{POL}: Emission Factor for Pollutant (lb/hour)
2000: Conversion Factor pounds to tons

- Vehicle Exhaust Emissions per Phase

$VMT_{VE} = PA * 0.25 * (1 / 27) * (1 / HC) * HT$

VMT_{VE}: Vehicle Exhaust Vehicle Miles Travel (miles)
PA: Paving Area (ft^2)
0.25: Thickness of Paving Area (ft)
(1 / 27): Conversion Factor cubic feet to cubic yards (1 yd^3 / 27 ft^3)
HC: Average Hauling Truck Capacity (yd^3)
(1 / HC): Conversion Factor cubic yards to trips (1 trip / HC yd^3)
HT: Average Hauling Truck Round Trip Commute (mile/trip)

$V_{POL} = (VMT_{VE} * 0.002205 * EF_{POL} * VM) / 2000$

V_{POL}: Vehicle Emissions (TONs)
VMT_{VE}: Vehicle Exhaust Vehicle Miles Travel (miles)
0.002205: Conversion Factor grams to pounds
EF_{POL}: Emission Factor for Pollutant (grams/mile)
VM: Vehicle Exhaust On Road Vehicle Mixture (%)
2000: Conversion Factor pounds to tons

- Worker Trips Emissions per Phase

$VMT_{WT} = WD * WT * 1.25 * NE$

VMT_{WT}: Worker Trips Vehicle Miles Travel (miles)
WD: Number of Total Work Days (days)
WT: Average Worker Round Trip Commute (mile)
1.25: Conversion Factor Number of Construction Equipment to Number of Works
NE: Number of Construction Equipment

$V_{POL} = (VMT_{WT} * 0.002205 * EF_{POL} * VM) / 2000$

V_{POL}: Vehicle Emissions (TONs)
VMT_{VE}: Worker Trips Vehicle Miles Travel (miles)
0.002205: Conversion Factor grams to pounds
EF_{POL}: Emission Factor for Pollutant (grams/mile)
VM: Worker Trips On Road Vehicle Mixture (%)
2000: Conversion Factor pounds to tons

- Off-Gassing Emissions per Phase
$VOC_P = (2.62 * PA) / 43560$

VOC_P: Paving VOC Emissions (TONs)
2.62: Emission Factor (lb/acre)
PA: Paving Area (ft^2)
43560: Conversion Factor square feet to acre (43560 ft2 / acre)^2 / acre)

3. Personnel

3.1 General Information & Timeline Assumptions

- Add or Remove Activity from Baseline? Add

- Activity Location
County: Santa Barbara
Regulatory Area(s): NOT IN A REGULATORY AREA

- Activity Title: Vulcan Centaur Program, SLC-3E, VAFB, Temporary Construction Personnel

- Activity Description:
ULA Vulcan Centaur Program temporary construction support personnel at SLC-3E is not anticipated to exceed 100 people during the period of performance.

ULA Vulcan Centaur Program launch and operations personnel will manintain the same quantity of personnel that currently support the ULA Atlas and Delta Programs. No increase or decrease in personnel is anticipated and therefore not evaulated as an empact associatd with the Proposed Action.

- Activity Start Date
Start Month: 1
Start Year: 2022

- Activity End Date
Indefinite: No
End Month: 6
End Year: 2023

- Activity Emissions:

Pollutant	Total Emissions (TONs)
VOC	0.518227
SO_x	0.006164
NO_x	0.281725
CO	3.361346
PM 10	0.081188

Pollutant	Total Emissions (TONs)
PM 2.5	0.035295
Pb	0.000000
NH_3	0.041549
CO_2e	593.8

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3.2 Personnel Assumptions

- Number of Personnel

Active Duty Personnel:	0
Civilian Personnel:	0
Support Contractor Personnel:	100
Air National Guard (ANG) Personnel:	0
Reserve Personnel:	0

- Default Settings Used: No

- Average Personnel Round Trip Commute (mile): 40

- Personnel Work Schedule

Active Duty Personnel:	5 Days Per Week
Civilian Personnel:	5 Days Per Week
Support Contractor Personnel:	5 Days Per Week
Air National Guard (ANG) Personnel:	4 Days Per Week
Reserve Personnel:	4 Days Per Month

3.3 Personnel On Road Vehicle Mixture

- On Road Vehicle Mixture (%)

	LDGV	LDGT	HDGV	LDDV	LDDT	HDDV	MC
POVs	37.55	60.32	0	0.03	0.2	0	1.9
GOVs	54.49	37.73	4.67	0	0	3.11	0

3.4 Personnel Emission Factor(s)

- On Road Vehicle Emission Factors (grams/mile)

	VOC	SO_x	NO_x	CO	PM 10	PM 2.5	Pb	NH_3	CO_2e
LDGV	000.114	000.003	000.084	000.992	000.047	000.020		000.023	00298.845
LDGT	000.288	000.004	000.178	001.871	000.048	000.021		000.024	00379.038
HDGV	000.600	000.011	001.339	008.875	000.183	000.078		000.045	01128.468
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LDDT	000.094	000.003	000.533	000.594	000.112	000.082		000.008	00364.857
HDDV	000.194	000.014	004.796	001.133	000.211	000.117		000.028	01514.699
MC	004.452	000.002	001.252	023.791	000.019	000.009		000.054	00187.891

3.5 Personnel Formula(s)

- Personnel Vehicle Miles Travel for Work Days per Year

$VMT_P = NP * WD * AC$

VMT_P: Personnel Vehicle Miles Travel (miles/year)
NP: Number of Personnel
WD: Work Days per Year
AC: Average Commute (miles)

DETAIL AIR CONFORMITY APPLICABILITY MODEL REPORT

- Total Vehicle Miles Travel per Year

$VMT_{Total} = VMT_{AD} + VMT_{C} + VMT_{SC} + VMT_{ANG} + VMT_{AFRC}$

VMT_{Total}: Total Vehicle Miles Travel (miles)
VMT_{AD}: Active Duty Personnel Vehicle Miles Travel (miles)
VMT_{C}: Civilian Personnel Vehicle Miles Travel (miles)
VMT_{SC}: Support Contractor Personnel Vehicle Miles Travel (miles)
VMT_{ANG}: Air National Guard Personnel Vehicle Miles Travel (miles)
VMT_{AFRC}: Reserve Personnel Vehicle Miles Travel (miles)

- Vehicle Emissions per Year

$V_{POL} = (VMT_{Total} * 0.002205 * EF_{POL} * VM) / 2000$

V_{POL}: Vehicle Emissions (TONs)
VMT_{Total}: Total Vehicle Miles Travel (miles)
0.002205: Conversion Factor grams to pounds
EF_{POL}: Emission Factor for Pollutant (grams/mile)
VM: Personnel On Road Vehicle Mixture (%)
2000: Conversion Factor pounds to tons

APPENDIX F

Section 106 and 110 National Historic Preservation Act of 1966 Consultation Documentation

State of California • Natural Resources Agency

Gavin Newsom, *Governor*

DEPARTMENT OF PARKS AND RECREATION
OFFICE OF HISTORIC PRESERVATION
STATE HISTORICAL RESOURCES COMMISSION

Julianne Polanco, State Historic Preservation Officer

1725 23rd Street, Suite 100, Sacramento, CA 95816-7100
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Marshall McKay
René Vellanoweth, PhD

November 3, 2020

Reply in Reference to: USAF_2020_1007_001

Lt. Col. Charles G. Hansen
Commander, 30th Civil Engineer Squadron
1172 Iceland Avenue
Vandenberg AFB, CA 93437-6011

VIA ELECTRONIC MAIL

Re: Section 106 Consultation for Space Launch Complex-Three East Conversion, Vulcan Centaur Program, Vandenberg AFB

Dear Lt. Col. Hansen:

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

To accommodate the launch of the Vulcan Centaur Launch Program, the USAF is proposing to modify Space Launch Complex 3-East. Project components include the installation of a pre-constructed fixed launch platform, modifications to Building 945 (Solid Motor Building) increased capacity of mobile service tower and the addition of a liquid natural gas system.

Constructed in approximately 1975, Building 945 was formally determined not eligible for National Register of Historic Places (NRHP) inclusion. Archeological sites CA-SBA-534, and 549 were formally determined eligible for the NRHP and although they will not be affected by propose project activities, the USAF determined their proximity to the project area necessitates the presence of an archaeological monitor and will consult with the Santa Ynez Band of Chumash Indians to determine whether a Native American monitor will also be required.

The USAF are requesting concurrence with its delineation of the project's area of potential effects (APE) and its finding of no historic properties affected. Upon review of the information provided, the SHPO offers the following comments:

1) Pursuant to 36 CFR Part 800.4(a)(1), the SHPO does not object to the USAF's APE definition.

2) The SHPO concurs that a finding of no historic properties affected is appropriate. Be advised that that under certain circumstances, such as an unanticipated discovery or a change in project description, the USAF may have future responsibilities for this undertaking under 36 CFR Part 800.

Notify Historian Ed Carroll at (916) 445-7006 or Ed.Carroll@parks.ca.gov if there are any questions or concerns.

Sincerely,

Julianne Polanco
State Historic Preservation Officer

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

VIA EMAIL

Christopher Ryan
30 CES/CEIEA
1028 Iceland Avenue
Vandenberg SFB CA 93437

August 30, 2021

Mr. Sam Cohen
Santa Ynez Band of Chumash Indians
P.O. Box 517
Santa Ynez CA 93460

RE: Vulcan Centaur Launch Program (USAF_2020_1007_001)

Dear Sam

Space Launch Delta 30 (SLD 30) of the United States Space Force (USSF), Vandenberg Space Force Base (SFB), is continuing consultation with the Santa Ynez Band of Chumash Indians (Tribe) pursuant to Section 106 of the National Historic Preservation Act (NHPA) regarding the United Launch Alliance's (ULA) proposed *Vulcan Centaur Launch Program at Space Launch Complex 3* (SLC-3). This letter is provided to the Tribe for the purposes of summarizing consultation to date between SLD 30 and the Tribe and obtaining confirmation that the Tribe has no further comments.

On 19 August 2021 you and I met in Santa Ynez to discuss the proposed project and the supporting archaeological investigations performed by Applied EarthWorks. To review:

1. SLD 30 initiated consultation on the ULA's proposed Vulcan Centaur Launch Program back in November 2020, and I discussed the project briefly with you during an in-person meeting in Santa Ynez on 5 November 2020. Shortly thereafter, SLD 30 provided the Tribe with Applied EarthWorks' report of field investigations.

2. ULA's proposed Vulcan Centaur Launch Program would entail missile assembly at buildings located at SLC-6 and, subsequently, transport of the assembled missile to SLC-3 East. Transporting the missile safely requires a small amount of roadway widening at three intersections along the Vulcan Booster Transport Route, and at the approach to the pad at SLC-3 East, and expansion of the paved area at Building 945.

3. On August 18, 19, and 26, 2020, Applied Earthworks conducted a pedestrian survey at all locations within the project areas and excavated eight shovel test pits at three of the locations to assess whether archaeological materials exist within the project areas.

4. At the intersection of Bear Creek Road and Coast Road, excavations revealed disturbed soils and road base gravels to at least 40 centimeters below surface. No archaeological or

historic materials were found. This area is not within an archaeological site.

5. At the intersection of Lunar Avenue and Lunar Road, excavations at the north side and south side of this intersection revealed disturbed soils to 65 centimeters below surface. No archaeological or historic materials were encountered. This area is not within an archaeological site.

6. At the intersection of Bear Creek Road and Napa Road, past excavations at CA-SBA-2426 revealed disturbed soils to 100 centimeters below surface. No prehistoric or historical archaeological materials were observed during the recently completed survey where road widening would occur, which is not within an archaeological site.

7. At the SLC-3 East pad entry control approach area, in the vicinity of isolated artifact VAFB-ISO-209, excavations revealed disturbed soils to 60 centimeters below surface. No prehistoric or historical archaeological materials were observed during survey.

8. Excavations at Building 945 revealed disturbed soils and road base gravels to at least 35 centimeters below surface. No archaeological or historic material were observed. This area is not within an archaeological site.

To conclude, SLD 30 respectfully requests the Tribe indicate its view of the completeness of the effort to identify all cultural resources within the APE below. Thank you very much for your continued assistance with this undertaking.

Sincerely

Christopher Ryan

RYAN.CHRISTOPHER.D.1296630701

Digitally signed by RYAN.CHRISTOPHER.D.1296630701
Date: 2021.08.30 09:41:03 -07'00'

CHRISTOPHER RYAN
Cultural Resources Manager, 30 CES/CEIEA

At this time, the Tribe:

☐ Wishes to provide additional Tribal comments.

☒ Concurs that the effort to identify cultural resources within the action areas is satisfactory.

Signature

9/2/21
Date

APPENDIX G

California Coastal Commission, Negative Determination (ND-0027-20) Documentation

CALIFORNIA COASTAL COMMISSION
455 MARKET STREET, SUITE 300
SAN FRANCISCO, CA 94105-2421
VOICE (415) 904-5200
FAX (415) 904-5400

October 8, 2020

Beatrice L Kephart
Chief, Installation Management Flight
Department of the Air Force
30 CES/CEI
1028 Iceland Avenue
Vandenberg AFB CA 93437-6010

Subject: Negative Determination ND-0027-20 (Vulcan Centaur Program, Vandenberg Air Force Base, Santa Barbara County)

Dear Ms. Kephart:

The Coastal Commission staff has reviewed the above-referenced negative determination. The U.S. Air Force (Air Force) proposes to develop United Launch Alliance's (ULA) new Vulcan Centaur Program and make minor modifications within the present boundary of the Space Launch Complex 3 East (SLC-3E) and surrounding Vandenberg Air Force Base (VAFB) locations to support the launch program. The proposed project involves modifications to existing SLC-3E infrastructure and roadway intersections, as well as launches of the new Vulcan Centaur Vehicle on VAFB. The Vulcan Centaur Program will comply with the current Air Force Launch Service Agreement (LSA). The Vulcan Centaur Program would have a maximum of six launches per year, comparable to past launch programs that ranged from two to eight launches per year at SLC-3E. ULA plans to phase out the current launch programs, Atlas V and Delta IV, and Delta II was retired in 2019.

The proposed roadway modifications are required to accommodate the Vulcan Centaur vehicle and include the following elements:

- Intersection of Luner Road and Coast Road: Widen turning radius at intersection and increase width of Luner Road along 200 linear feet.
- Intersection of Coast Road and Bear Creek Road: Increase width of Bear Creek Road along 200 linear feet.
- Intersection of Bear Creek Road and Napa Road: Widen turning radius at intersection and increase width of Bear Creek Road along 200 linear feet.
- Intersection of Utah Avenue and 10th Street: Widen approach apron and increase width of Utah Avenue along 400 linear feet.
- SLC-3E Entry Control Point: Widen main entrance and turning radius at the Entry Control Point.

These roadway and access modifications are not expected to have adverse impacts on natural resources as the activities would occur within the developed SLC-3E perimeter

fence and existing roadway shoulders. As directed by the Sikes Act and AFMAN 32-7003, Environmental Conservation, the Air Force is committed to long-term management of natural areas on its installations, which includes wetland protection, conservation of threatened and endangered species, and habitat restoration. Past surveys have not reported any special-status plant species within the areas of the proposed Project modifications. Construction noise is expected to be similar to ambient daily operational noise and would not adversely impact wildlife.

Vulcan Centaur launch preparation and operation activities are not expected to have significant impacts to natural resources, similar to past program launches at VAFB. Some impacts to vegetation are expected near the launch pad in an area approximately the same size as past similarly sized launch vehicles. Vegetation impacts include scorched vegetation and acid deposition. Past scorching did not permanently affect vegetation. The Air Force analyzed environmental impacts from past launches that resulted in acid deposition and found that there were no significant impacts to natural resources. Acid ground clouds resulting from launches could temporarily affect species however, their effects would be minimal and short-term. Acid deposition from Vulcan Centaur launches is expected to be within the range of past launch programs. According to the Air Force, the effects of sonic booms on marine species are not known. Sonic booms are expected to be infrequent and their footprint would be spread out over 42 miles from VAFB. An early launch abort or failure is possible however not likely, launch vehicles from similar programs have a proven record of successful launches and a reliability of approximately 95 percent. In the anomalous event that a launch fails, it is unlikely that launch vehicle debris would hit any marine life due to the low density of species in the ocean's surface water. Any liquid propellant from the launch vehicle would be consumed in the launch failure or be dispersed in the air and would be considered a negligible hazard. Post-launch monitoring of past launches and environmental analyses concluded that launch impacts to wildlife are minimal and no animal mortality at VAFB could be attributed to launch activities. ULA will comply with the 2019 Letter if Authorization (LOA) under 50 CFR 217, Subpart G - Taking of Marine Mammals Incidental to Rocket and Missile Launches and Aircraft Operations at VAFB, subject to the provisions of the Marine Mammal Protection Act. The LOA includes mitigation and monitoring measures to minimize adverse impacts to wildlife including scheduling launches outside of harbor seal pupping season and marine mammal monitoring.

SLC-3 is eligible for the National Register of Historic Places (NRHP), however a Historic Buildings Survey and Historic American Engineering Record determined that no measures were needed to mitigate or minimize potential effects from similar launch programs at SLC-3. The Air Force has not found any historical or cultural resources in the footprint of the launch activities or roadway modifications in SLC-3E during past and current evaluations of the area. The Vulcan Centaur Program is not expected to adversely affect historical or cultural resources.

Public access to Surf Beach would be temporarily restricted for the public's safety during SLC-3E launches, which is expected to occur at a maximum of six times per year, although actual launches per year in the past have been less than six per year. The Air Force and Santa Barbara County have an evacuation and closure agreement in place which requires the Air Force to provide a launch notice at least 72 hours prior to beach closures and restricts closures to not exceed 48 hours. Disruptive noise levels resulting

from Vulcan Centaur launches would occur primarily in the footprint of VAFB and would not affect residential areas.

The Commission staff **agrees** that the proposed Vulcan Centaur Program and modifications at SLC-3E will not adversely affect coastal zone resources. Under the federal consistency regulations (15 CFR Section 930.35(a)), a negative determination can be submitted for an activity "which is the same or is similar to activities for which consistency determinations have been prepared in the past." We have previously concurred with similar launch programs and related modifications at Vandenberg Air Force Base (CC-30-96, CD-049-98, ND-103-03, ND-088-05, ND-0035-14, and ND-0020-15). The proposed launch program and modifications would not generate new adverse impacts on coastal resources not previously examined by the Commission. We therefore **concur** with your negative determination made pursuant to 15 CFR Section 930.35 of the NOOA Implementing regulations. Please contact Alexis Barrera at Alexis.Barrera@coastal.ca.gov should you have any questions regarding this matter.

Sincerely,

LARRY Simon

FOR JOHN AINSWORTH
Executive Director

cc: CCC - South Central Coast District

APPENDIX H

Technical Report, Noise Study for United Launch Alliance's Vulcan Centaur Launch Vehicle Operations at VAFB

Federal Aviation Administration

Memorandum

Date: December 9, 2019

To: Dan Murray, Office of Commercial Space Transportation (AST)

From: Donald Scata, Manager, Noise Division, Office of Environment and Energy (AEE)

Subject: Noise Modeling Methodology for the Environmental Assessment of United Launch Alliance Vulcan Centaur V Launch Operations at Vandenberg Air Force Base

The Office of Environment and Energy (AEE) has reviewed the proposed non-standard noise modeling methodology to be used in the Environmental Assessment of United Launch Alliance Vulcan Centaur V Launch Operations at Vandenberg Air Force Base.

As the FAA does not currently have an approved propulsion noise model for launch vehicles, in accordance with FAA Order 1050.1F, all non-standard noise analysis in support of the noise impact analysis for the National Environmental Policy Act (NEPA) must be approved by AEE. This letter serves as AEE's response to the method proposed in the Technical Memorandum "20191031_ULA_VAFB_BRRC_Noise_Model_Technical_Memo" prepared by Senior Vice President of Blue Ridge Research and Consulting, LLC (BRRC) Michael M. James on October 31, 2019,

The noise levels generated from commercial space launch vehicles will be predicted using the Launch Vehicle Acoustic Simulation Model (RUMBLE), a fully featured time-simulation model developed by BRRC.

The proposed methodology appears to be adequate for modeling propulsion for launch vehicles. Therefore, AEE concurs with the methodology proposed for this project. Please understand that this approval is limited to this particular Environmental Assessment and vehicle. Any additional projects using this or other launch noise methodologies or variations of launch vehicle will require separate approval.

Blue Ridge Research and Consulting, LLC

Technical Report

Noise Study for United Launch Alliance's Vulcan Centaur Launch Vehicle Operations at Vandenberg Air Force Base

November 22, 2019 (Final)

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Acronyms and Abbreviations

The following acronyms and abbreviations are used in the report:

BRRC	Blue Ridge Research and Consulting, LLC
CATEX	Categorical Exclusion
CNEL	Community Noise Equivalent Level
dB	Decibel
dBA	A-weighted Decibel Level
dBC	C-weighted Decibel Level
DI	Directivity Indices
DNL	Day-Night Average Sound Level
DoD	Department of Defense
DSM-1	Distributed Source Method 1
FAA	Federal Aviation Administration
ft	Foot/Feet
Hz	Hertz
lbf	Pound Force
lbs	Pound Mass
$L_{A,max}$	Maximum A-weighted OASPL in Decibels
L_{max}	Maximum Unweighted OASPL in Decibels
L_{pk}	Peak Sound Pressure Level in Decibels
NIHL	Noise-Induced Hearing Loss
NIOSH	National Institute for Occupational Safety and Health
OASPL	Overall Sound Pressure Level in Decibels
OSHA	Occupational Safety and Health Administration
EA	Environmental Assessment
Pa	Pascal
psf	Pounds per Square Foot
RUMBLE	The Launch Vehicle Acoustic Simulation Model
S.L.	Sea Level
ULA	United Launch Alliance
VAFB	Vandenberg Air Force Base

1 Introduction

This report documents the noise study performed as part of United Launch Alliance's (ULA) efforts on the Environmental Assessment (EA) or Categorical Exclusion (CATEX) for proposed Vulcan Centaur launch operations at Vandenberg Air Force Base (VAFB). ULA plans to conduct launch operations of multiple Vulcan Centaur configurations from VAFB Space Launch Complex 3 (SLC-3). The most powerful configuration, a single Vulcan Centaur core and six GEM-63XL strap-on solid rocket boosters (SRB's) as shown in Figure 1, will be modeled to determine the envelope of the potential noise impacts. Noise impacts will be evaluated for a nominal launch trajectory for up to six annual launches per year. The potential impacts from propulsion noise and sonic boom are evaluated on a single-event and cumulative basis in relation to human annoyance, hearing conservation, and structural damage.

This noise study describes the environmental noise associated with the proposed Vulcan operations. Section 2 describes the proposed Vulcan operations; Section 3 summarizes the basics of sound and describes the noise metrics and impact criteria discussed throughout this report; Section 4 describes the general methodology of the propulsion noise and sonic boom modeling; and Section 5 presents the propulsion noise and sonic boom modeling results. A summary is provided in Section 6 to document the notable findings of this noise study.

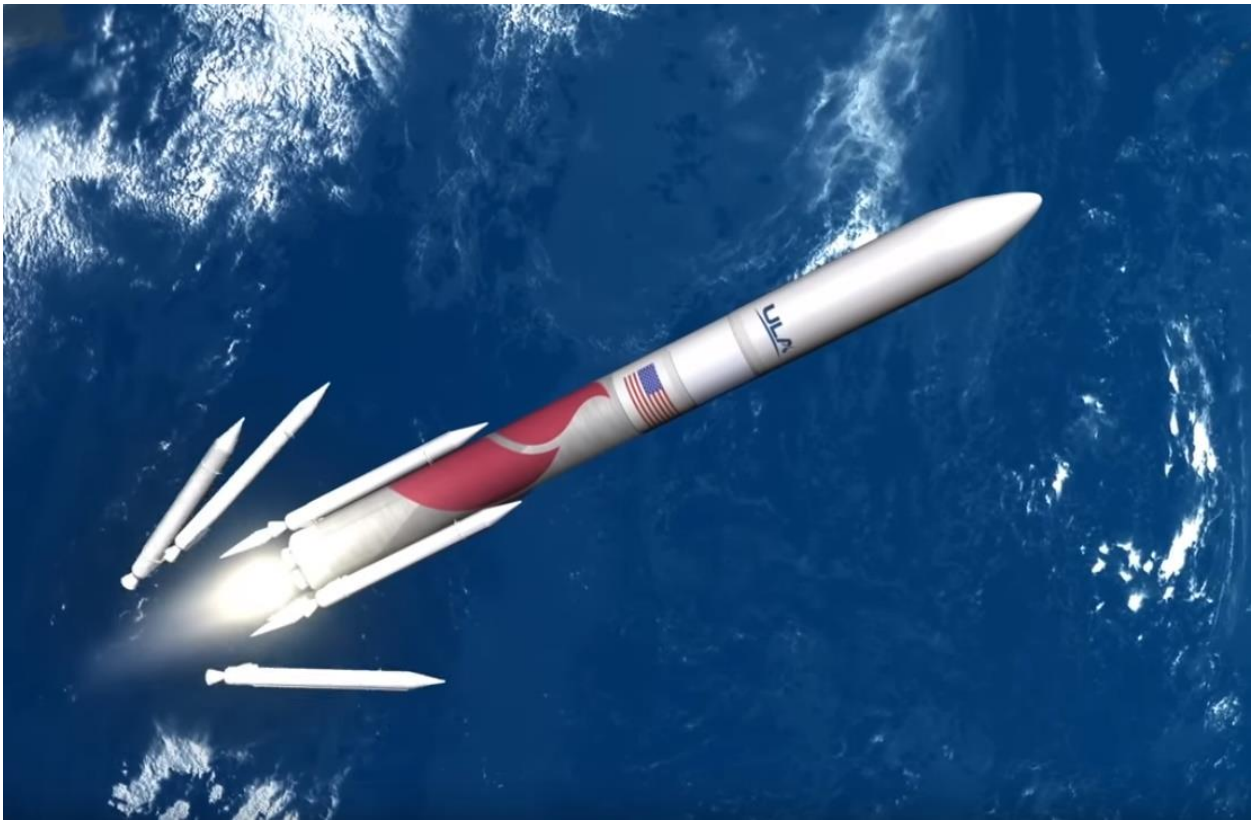

Figure 1. Rendering of ULA's Vulcan Centaur launch vehicle (credit: ULA)

2 Vulcan Centaur Operations

ULA plans to conduct Vulcan Centaur operations for up to 6 vertical launches per year. The annual operations are presented in Table 1 in terms of acoustic time of day. All launch events will occur at ULA's VAFB SLC-3 (34.6402°N, 120.5896°W). Vulcan Centaur launch trajectories departing from SLC-3 will be unique to the vehicle configuration, mission, and environmental conditions. For the purposes of this study, the noise modeling utilized a nominal launch trajectory provided by ULA with an azimuth of approximately 188°, relative to true north. An overview of the facility and nominal trajectory is shown in Figure 2.

Table 1. Proposed ULA Vulcan Centaur operations

		Annual Operations			
		Daytime	Evening	Nighttime	
Vehicle	**Event**	0700 – 1900	1900 – 2200	2200-0700	Total
Vulcan Centaur	Launch	3	1	2	6

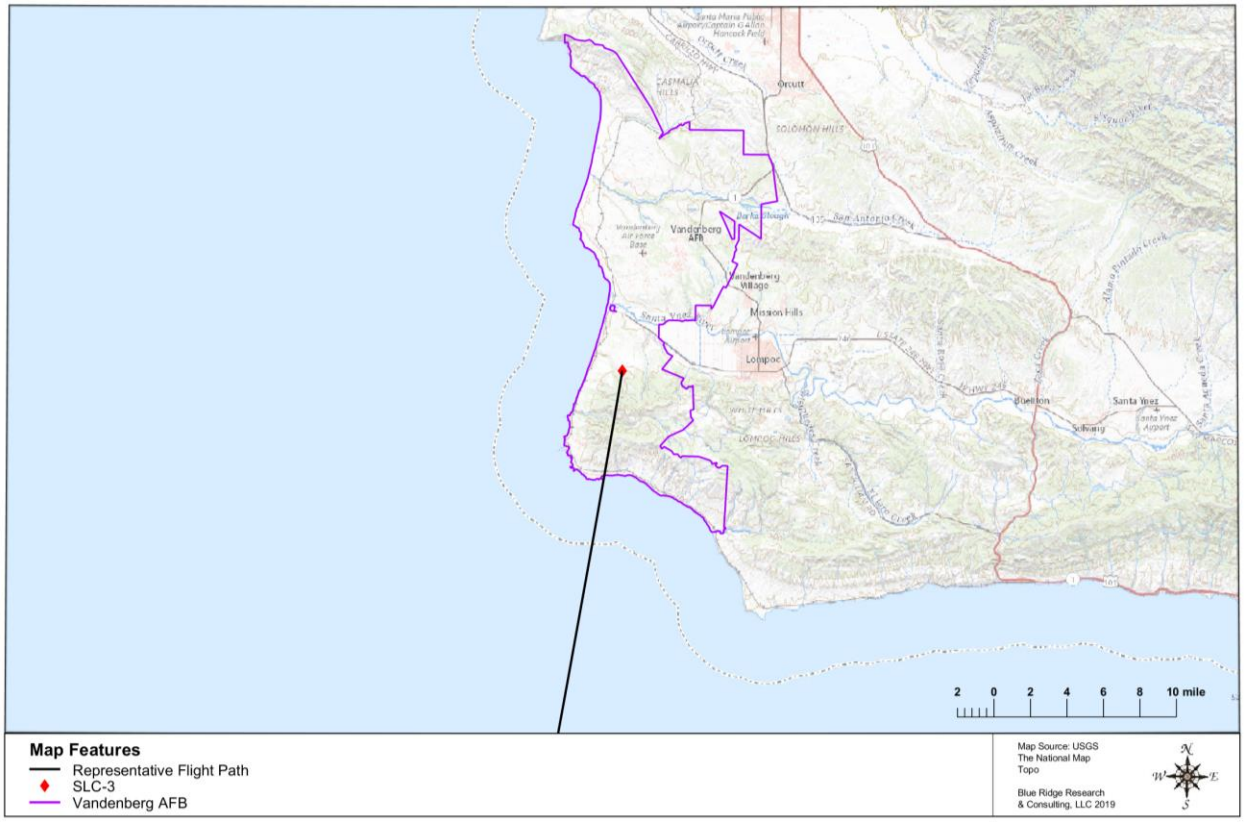

Figure 2. Overview of the VAFB facility boundary and nominal trajectory from SLC-3

Multiple Vulcan Centaur configurations will launch from SLC-3. Each configuration will utilize the ULA Booster Core with two Blue Origin BE-4 engines and may be supplemented by two, four, or six GEM 63XL SRBs to increase the rocket's lift capacity as needed. The most powerful configuration will be modeled to determine the potential extent of noise impacts. The vehicle parameters for the most powerful Vulcan Centaur configuration are presented in Table 2. Although the engine/motor thrusts are provided in Table 2, the model uses the time varying thrust profile provided in the nominal Vulcan Centaur launch trajectory, reaching a first stage combined maximum of 3,585,000 lbf. All operational modeling parameters were provided by ULA.

Table 2. Vulcan Centaur modeling parameters

Modeling Parameters	Values
Manufacturer	United Launch Alliance
Name	Vulcan Centaur
Length	221 ft
Diameter	17.7 ft
Gross Vehicle Weight	2,007,894 lbs
Vulcan Core	Blue Origin BE-4 Engines (Qty. 2) 550,000 lbf S.L. Thrust/Engine
Solid Rocket Motors	Northrop Grumman Innovation Systems GEM-63XL Motors (Qty. 6) 460,000 lbf S.L. Thrust/Motor

3 Acoustics Overview

An overview of sound-related terms, metrics, and effects, which are pertinent to this study, is provided to assist the reader in understanding the terminology used in this noise study.

3.1 Fundamentals of Sound

Any unwanted sound that interferes with normal activities or the natural environment is defined as noise. Three principal physical characteristics are involved in the measurement and human perception of sound: intensity, frequency, and duration [1].

- **Intensity** is a measure of a sound's acoustic energy and is related to sound pressure. The greater the sound pressure, the more energy is carried by the sound and the louder the perception of that sound.
- **Frequency** determines how the pitch of the sound is perceived. Low-frequency sounds are characterized as rumbles or roars, while high-frequency sounds are typified by sirens or screeches.
- **Duration** is the length of time the sound can be detected.

3.1.1 Intensity

The loudest sounds that can be comfortably detected by the human ear have intensities a trillion times higher than those of sounds barely audible. Because of this vast range, using a linear scale to represent the intensity of sound can become cumbersome. As a result, a logarithmic unit known as the decibel (abbreviated dB) is used to represent sound levels. A sound level of 0 dB approximates the threshold of human hearing and is barely audible under extremely quiet listening conditions. Normal speech has a sound level around 60 dB. Sound levels above 120 dB begin to be felt inside the human ear as discomfort. Sound levels between 130 and 140 dB are experienced as pain [2].

Because of the logarithmic nature of the decibel unit, sound levels cannot be simply added or subtracted and are somewhat cumbersome to handle mathematically. However, some useful rules help when dealing with sound levels. First, if a sound's intensity is doubled, the sound level increases by 3 dB, regardless of the initial sound level. For example:

$$50\ \text{dB} + 50\ \text{dB} = 53\ \text{dB}, \text{ and } 70\ \text{dB} + 70\ \text{dB} = 73\ \text{dB}.$$

Second, the total sound level produced by two sounds with different levels is usually only slightly more than the higher of the two. For example:

$$50.0\ \text{dB} + 60.0\ \text{dB} = 60.4\ \text{dB}.$$

On average, a person perceives a change in sound level of about 10 dB as a doubling (or halving) of a sound's loudness. This relation holds true for both loud and quiet sounds. A decrease in sound level of 10 dB represents a 90% decrease in sound intensity but only a 50% decrease in perceived loudness because the human ear does not respond linearly [1]. In the community, "it is unlikely that the average listener would be able to correctly identify at a better than chance level the louder of two otherwise similar events which differed in maximum sound level by < 3 dB" [3].

The intensity of sonic booms is quantified with physical pressure units rather than levels. Intensities of sonic booms are traditionally described by the amplitude of the front shock wave, referred to as the peak overpressure. The peak overpressure is normally described in units of pounds per square foot (psf). The

amplitude is particularly relevant when assessing structural effects as opposed to loudness or cumulative community response. In this study, sonic booms are quantified by either dB or psf, as appropriate for the particular impact being assessed [4].

3.1.2 Frequency

Sound frequency is measured in terms of cycles per second or hertz (Hz). Human hearing ranges in frequency from 20 Hz to 20,000 Hz, although perception of these frequencies is not equivalent across this range. Human hearing is most sensitive to frequencies in the 1,000 to 4,000 Hz range. Most sounds are not simple pure tones, but contain a mix, or spectrum, of many frequencies. Sounds with different spectra are perceived differently by humans even if the sound levels are the same. Weighting curves have been developed to correspond to the sensitivity and perception of different types of sound. A-weighting and C-weighting are the two most common weightings. These two curves, shown in Figure 3, are adequate to quantify most environmental noises. A-weighting puts emphasis on the 1,000 to 4,000 Hz range to match the reduced sensitivity of human hearing for moderate sound levels. For this reason, the A-weighted decibel level (dBA) is commonly used to assess community sound.

Very loud or impulsive sounds, such as explosions or sonic booms, can sometimes be felt, and they can cause secondary effects, such as shaking of a structure or rattling of windows. These types of sounds can add to annoyance and are best measured by C-weighted sound levels, denoted dBC. C-weighting is nearly flat throughout the audible frequency range and includes low frequencies that may not be heard but cause shaking or rattling. C-weighting approximates the human ear's sensitivity to higher intensity sounds. Note, "unweighted" sound levels refer to levels in which no weighting curve has been applied to the spectra. Unweighted levels are appropriate for use in examining the potential for noise impacts on structures.

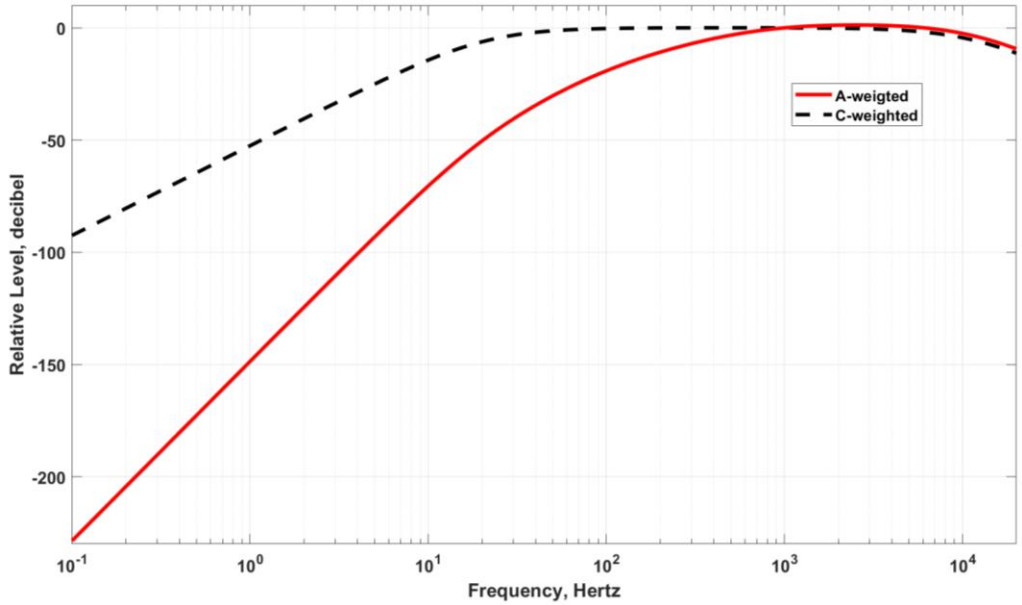

Figure 3. Frequency adjustments for A-weighting and C-weighting [5]

3.1.3 Duration

Sound sources can contain a wide range of frequency (pitch) content as well as variations in extent from short durations to continuous, such as back-up alarms and ventilation systems, respectively. Some sound sources (air conditioners, generators, lawn mowers) are continuous with levels that are constant for a given duration; others (vehicles passing by) are the maximum sound during an event, and some (urban day and nighttime) are averages over extended periods [6]. Sonic booms are considered low-frequency impulsive noise events with durations lasting a fraction of a second.

3.1.4 Common Sounds

Common sources of noise and their associated levels are provided for comparison to the noise levels from the proposed action.

A chart of A-weighted sound levels from everyday sounds [7] is shown in Figure 4. Per the US Environmental Protection Agency, "Ambient noise in urban areas typically varies from 60 to 70 dB but can be as high as 80 dB in the center of a large city. Quiet suburban neighborhoods experience ambient noise levels around 45-50 dB" [8].

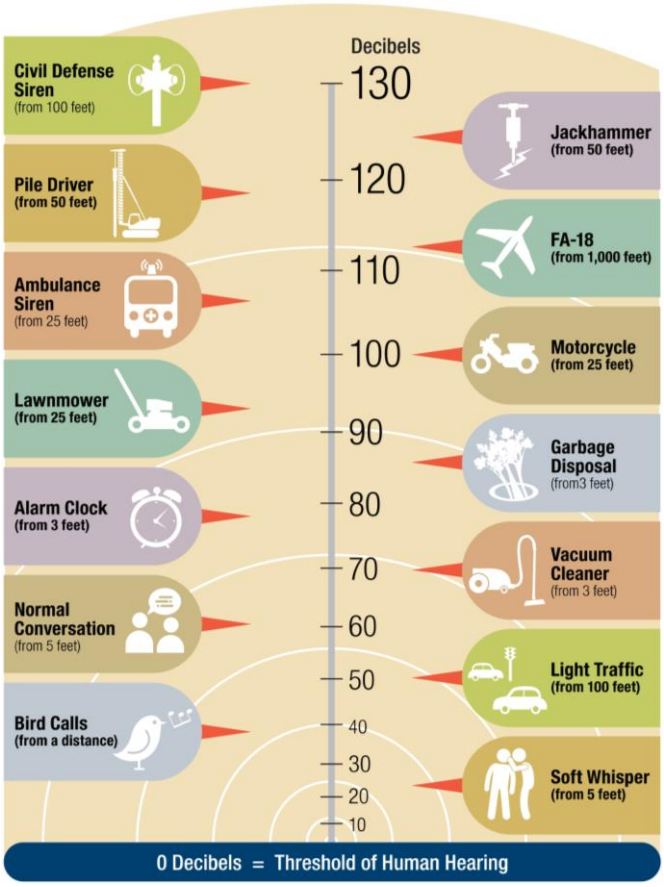

Figure 4. Typical A-weighted sound levels of common sounds [9]

A chart of typical impulsive events along with their corresponding peak overpressures in terms of psf and peak dB values are shown in Figure 5. For example, thunder overpressure resulting from lightning strikes

at a distance of one kilometer (0.6 miles) is estimated to be near two psf, which is equivalent to 134 dB [10].

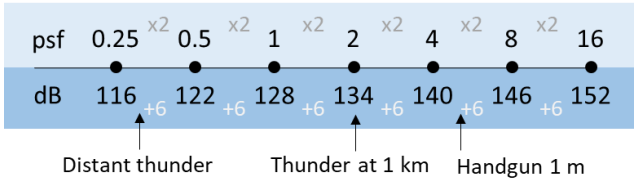

Figure 5. Typical impulsive event levels [10]

3.2 Noise Metrics

A variety of acoustical metrics have been developed to describe sound events and to identify any potential impacts to receptors within the environment. These metrics are based on the nature of the event and who or what is affected by the sound. A brief description of the noise metrics used in this noise study are provided below.

Maximum Sound Level (L_{max})

The highest unweighted sound level measured during a single event, in which the sound changes with time, is called the Maximum Sound Level (abbreviated as L_{max}). The highest A-weighted sound level measured during a single event is called the Maximum A-weighted Sound Level (abbreviated as $L_{A,max}$). Although it provides some measure of the event, L_{max} (or $L_{A,max}$) does not fully describe the sound because it does not account for how long the sound is heard.

Peak Sound Level (L_{pk})

For impulsive sounds, the true instantaneous peak sound pressure level, which lasts for only a fraction of a second, is important in determining impacts. The peak pressure of the front shock wave is used to describe sonic booms, and it is usually presented in psf. Peak sound levels are not frequency weighted.

Day-Night Average Sound Level (DNL) and Community Noise Equivalent Level (CNEL)

Day-Night Average Sound Level is a cumulative metric that accounts for all noise events in a 24-hour period. To account for increased sensitivity to noise at night, DNL applies an additional 10 dB adjustment to events during the acoustical nighttime period, defined as 10:00 PM to 7:00 AM. DNL represents the average sound level exposure for annual average daily events. Legislation in the state of California uses the Community Noise Equivalent Level (CNEL), a variant of the DNL. In addition to the 10 dB (i.e. 10 times weighting) adjustment during the acoustical nighttime period, the CNEL includes a ~4.8 dB adjustment (i.e. 3 times weighting) to events during the acoustical evening period (7:00 PM to 10:00 PM) to account for decreased community noise during this period. DNL and CNEL do not represent a level heard at any given time but represent long term exposure to noise.

3.3 Noise Effects

Noise criteria have been developed to protect the public health and welfare of the surrounding communities. The impacts of launch vehicle noise and sonic booms are evaluated on a cumulative basis in terms of human annoyance. In addition, the launch vehicle noise and sonic boom impacts are evaluated on a single-event basis in relation to hearing conservation and potential structural damage. Although FAA

Order 1050.1F does not have guidance on hearing conservation or structural damage criteria, it recognizes the use of supplemental noise analysis to describe the noise impact and assist the public's understanding of the potential noise impact.

3.3.1 Human Annoyance

A significant noise impact would occur if the "action would increase noise by DNL 1.5 dB[A] or more for a noise sensitive area that is exposed to noise at or above the DNL 65 dB[A] noise exposure level, or that will be exposed at or above this level due to the increase, when compared to the No Action Alternative for the same timeframe" [11].

DNL is based on long-term cumulative noise exposure and has been found to correlate well with long-term community annoyance for regularly occurring events including aircraft, rail, and road noise [12, 13]. Noise studies used in the development of the DNL metric did not include rocket noise, which are historically irregularly occurring events. Thus, it is acknowledged that the suitability of DNL for infrequent rocket noise events is uncertain. Additionally, it has been noted that the DNL "threshold does not adequately address the effects of noise on visitors to areas within a national park or national wildlife refuge where other noise is very low and a quiet setting is a generally recognized purpose and attribute" [11]. However, DNL is the most widely accepted metric to estimate the potential changes in long-term community annoyance. For launch propulsion noise, A-weighted DNL is used to assess the community impacts with regards to human annoyance. For impulsive noise sources with significant low-frequency content such as sonic booms, C-weighted DNL is preferred over A-weighted DNL [14]. In terms of percent highly annoyed, DNL 65 dBA is equivalent to CDNL 60 dBC [15]. Within the state of California, the potential for community impacts with regards to human annoyance are assessed using CNEL (see Section 3.2), a variant of DNL. The threshold levels for CNEL are the same for DNL.

3.3.2 Hearing Conservation

Launch Vehicle Noise

U.S. government agencies have provided guidelines on permissible noise exposure limits. These documented guidelines are in place to protect human hearing from long-term continuous daily exposures to high noise levels and aid in the prevention of noise-induced hearing loss (NIHL). A number of federal agencies have set exposure limits on non-impulsive noise levels, including the Occupational Safety and Health Administration (OSHA) [16], National Institute for Occupational Safety and Health (NIOSH) [17], and the Department of Defense (DoD) Occupational Hearing Conservation Program [18]. The most conservative of these upper noise level limits has been set by OSHA at 115 dBA. At 115 dBA, the allowable exposure duration is 15 minutes for OSHA and 28 seconds for NIOSH and DoD. $L_{A,max}$ contours are used to identify potential locations where hearing protection should be considered for rocket operations.

Sonic Booms

Multiple federal government agencies have provided guidelines on permissible noise exposure limits on impulsive noise such as sonic booms. In terms of upper limits on impulsive or impact noise levels, NIOSH [17] and OSHA [19] have stated that levels should not exceed 140 dB peak sound pressure level, which equates to a sonic boom level of approximately 4 psf.

3.3.3 Structural Damage

Launch Vehicle Noise

Typically, the most sensitive components of a structure to launch vehicle noise are windows, and infrequently, the plastered walls and ceilings. The potential for damage to a structure is unique interaction among the incident sound, the condition of the structure, and the material of each element and its respective boundary conditions. A report from the National Research Council on the "Guidelines for Preparing Environmental Impact Statements on Noise" [20] states that one may conservatively consider all sound lasting more than one second with levels exceeding 130 dB (unweighted) as potentially damaging to structures.

A NASA technical memo examined the relationship between structural damage claims and overall sound pressure level and concluded "the probability of structural damage [was] proportional to the intensity of the low frequency sound" [21]. This relationship estimated that one damage claim in 100 households exposed is expected at an average continuous sound level of 120 dB (unweighted), and one in 1,000 households at 111 dB (unweighted). The study was based on community responses to 45 ground tests of the first and second stages of the Saturn V rocket system conducted in Southern Mississippi over a period of five years. The sound levels used to develop the criteria were modeled mean sound levels.

It is important to highlight the difference between the static ground tests on which the rate of structural damage claims is based and the dynamic events modeled in this noise study. During ground tests, the engine/motor remains in one position, which results in a longer-duration exposure to continuous levels as opposed to the transient noise occurring from the moving vehicle during a launch event. Regardless of this difference, Guest and Slone's [21] damage claim criteria represents the best available dataset regarding the potential for structural damage resulting from rocket noise. Thus, L_{max} values of 120 dB (unweighted) and 111 dB (unweighted) are used in this report as conservative thresholds for potential risk of structural damage claims.

Sonic Booms

High-level sonic booms are also associated with structural damage. Most damage claims are for brittle objects, such as glass and plaster. Table 3 summarizes the threshold of damage that may be expected at various overpressures [22]. Additionally, Table 3 describes example impulsive events for each level range. A large degree of variability exists in damage experience, and much of the damage depends on the pre-existing condition of a structure. Breakage data for glass, for example, spans a range of two to three orders of magnitude at a given overpressure. The probability of a window breaking at 1 psf ranges from one in a billion [23] to one in a million [24]. These damage rates are associated with a combination of boom load and glass condition. At 10 psf, the probability of breakage is between one in 100 and one in 1,000. Laboratory tests involving glass [25] have shown that properly installed window glass will not break at overpressures below 10 psf, even when subjected to repeated booms. However, in the real world, glass is not always in pristine condition.

Damage to plaster occurs at similar ranges to glass damage. Plaster has a compounding issue in that it will often crack due to shrinkage while curing or from stresses as a structure settles, even in the absence of outside loads. Sonic boom damage to plaster often occurs when internal stresses are high as a result of these factors. In general, for well-maintained structures, the threshold for damage from sonic booms is 2 psf [22], below which damage is unlikely.

Table 3. Possible damage to structures from sonic booms [22]

Nominal level	Damage Type	Item Affected
0.5 – 2 psf *piledriver at construction site*	Plaster	Fine cracks; extension of existing cracks; more in ceilings; over doorframes; between some plasterboards.
	Glass	Rarely shattered; either partial or extension of existing.
	Roof	Slippage of existing loose tiles/slates; sometimes new cracking of old slates at nail hole.
	Damage to outside walls	Existing cracks in stucco extended.
	Bric-a-brac	Those carefully balanced or on edges can fall; fine glass, such as large goblets, can fall and break.
	Other	Dust falls in chimneys.
2 – 4 psf *cap gun/firecracker near ear*	Glass, plaster, roofs, ceilings	Failures show that would have been difficult to forecast in terms of their existing localized condition. Nominally in good condition.
4 – 10 psf *handgun at shooter's ear*	Glass	Regular failures within a population of well-installed glass; industrial as well as domestic greenhouses.
	Plaster	Partial ceiling collapse of good plaster; complete collapse of very new, incompletely cured, or very old plaster.
	Roofs	High probability rate of failure in nominally good state, slurry-wash; some chance of failures in tiles on modern roofs; light roofs (bungalow) or large area can move bodily.
	Walls (out)	Old, free standing, in fairly good condition can collapse.
	Walls (in)	Inside ("party") walls known to move at 10 psf.
> 10 psf *fireworks display from viewing stand*	Glass	Some good glass will fail regularly to sonic booms from the same direction. Glass with existing faults could shatter and fly. Large window frames move.
	Plaster	Most plaster affected.
	Ceilings	Plasterboards displaced by nail popping.
	Roofs	Most slate/slurry roofs affected, some badly; large roofs having good tile can be affected; some roofs bodily displaced causing gale-end and will-plate cracks; domestic chimneys dislodged if not in good condition.
	Walls	Internal party walls can move even if carrying fittings such as hand basins or taps; secondary damage due to water leakage.
	Bric-a-brac	Some nominally secure items can fall; e.g., large pictures, especially if fixed to party walls.

4 Noise Modeling

An overview of the propulsion noise and sonic boom modeling methodologies used in this noise study are presented in Section 4.1 and 4.2, respectively.

4.1 Propulsion Noise Modeling

Launch vehicle propulsion systems, such as solid rocket motors and liquid-propellant rocket engines, generate high-amplitude broadband noise. Most of the noise is created by the rocket plume interacting with the atmosphere and the combustion noise of the propellants. Although rocket noise radiates in all directions, it is highly directive, meaning that a significant portion of the source's acoustic power is concentrated in specific directions.

The Launch Vehicle Acoustic Simulation Model (RUMBLE), developed by Blue Ridge Research and Consulting, LLC (BRRC), is the noise model used to predict the noise associated with the proposed operations. The core components of the model are visualized in Figure 6 and are described in the following subsections.

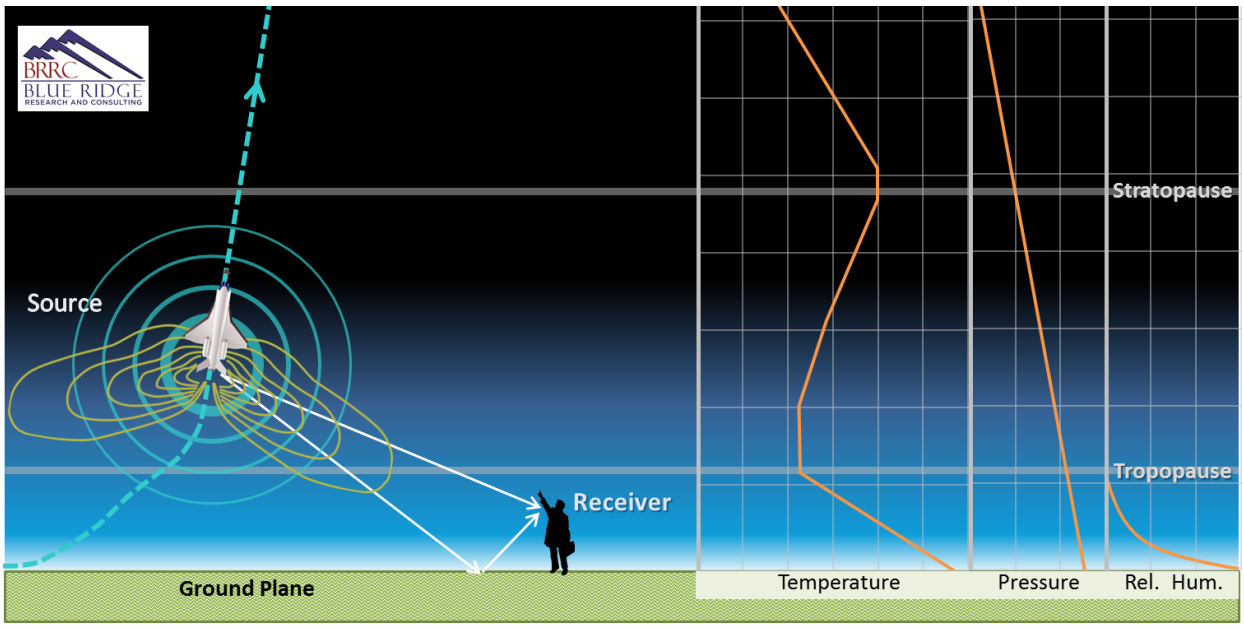

Figure 6. Conceptual overview of rocket noise prediction model methodology

4.1.1 Source

The rocket noise source definition considers the acoustic power of the rocket, forward flight effects, directivity, and the Doppler effect.

Acoustic Power

Eldred's Distributed Source Method 1 (DSM-1) [26] is utilized for the source characterization. The DSM-1 model determines the launch vehicle's total sound power based on its total thrust, exhaust velocity, and the engine/motor's acoustic efficiency. BRRC's recent validation of the DSM-1 model showed very good agreement between full-scale rocket noise measurements and the empirical source curves [27]. The acoustic efficiency of the rocket engine/motor specifies the percentage of the mechanical power

converted into acoustic power. The acoustic efficiency of the rocket engine/motor was modeled using Guest's variable acoustic efficiency [28]. Typical acoustic efficiency values range from 0.2% to 1.0% [26]. In the far-field, distributed sound sources are modeled as a single compact source located at the nozzle exit with an equivalent total sound power. Therefore, launch vehicle propulsion systems with multiple tightly clustered equivalent engines can be modeled as a single engine with an effective exit diameter and total thrust [26]. Additional boosters or cores (that are not considered to be tightly clustered) are handled by summing the noise contribution from each booster/core.

Forward Flight Effect

A rocket in forward flight radiates less noise than the same rocket in a static environment. A standard method to quantify this effect reduces overall sound levels as a function of the relative velocity between the jet plume and the outside airflow [29, 30, 31, 32]. This outside airflow travels in the same direction as the rocket exhaust. At the onset of a launch, the rocket exhaust travels at far greater speeds than the ambient airflow. Conversely, for a vertical landing, the rocket exhaust and ambient airflow travel in opposing directions, yielding an increased relative velocity differential. As the differential between the forward flight velocity and exhaust velocity decreases, jet plume mixing is reduced, which reduces the corresponding noise emission. Notably, the maximum sound levels are normally generated before the vehicle reaches the speed of sound. Thus, the modeled noise reduction is capped at a forward flight velocity of Mach 1.

Directivity

Rocket noise is highly directive, meaning the acoustic power is concentrated in specific directions, and the observed sound pressure will depend on the angle from the source to the receiver. NASA's Constellation Program has made significant improvements in determining launch vehicle directivity of the reusable solid rocket motor (RSRM) [33]. The RSRM directivity indices (DI) incorporate a larger range of frequencies and angles then previously available data. Subsequently, improvements were made to the formulation of the RSRM DI [34] accounting for the spatial extent and downstream origin of the rocket noise source. These updated DI are used for this analysis.

Doppler Effect

The Doppler effect is the change in frequency of an emitted wave from a source moving relative to a receiver. The frequency at the receiver is related to the frequency generated by the moving sound source and by the speed of the source relative to the receiver. The received frequency is higher (compared to the emitted frequency) if the source is moving towards the receiver, it is identical at the instant of passing by, and it is lower if the source is moving away from the receiver. During a rocket launch, an observer on the ground will hear a downward shift in the frequency of the sound as the distance from the source to receiver increases. The relative changes in frequency can be explained as follows: when the source of the waves is moving toward the observer, each successive wave crest is emitted from a position closer to the observer than the previous wave. Therefore, each wave takes slightly less time to reach the observer than the previous wave, and the time between the arrivals of successive wave crests at the observer is reduced, causing an increase in the frequency. While they are traveling, the distance between successive wave fronts is reduced such that the waves "bunch together." Conversely, if the source of waves is moving away

from the observer, then each wave is emitted from a position farther from the observer than the previous wave; the arrival time between successive waves is increased, reducing the frequency. Likewise, the distance between successive wave fronts increases, so the waves "spread out." Figure 7 illustrates this spreading effect for an observer in a series of images, where a) the source is stationary, b) the source is moving less than the speed of sound, c) the source is moving at the speed of sound, and d) the source is moving faster than the speed of sound. As the frequency is shifted lower, the A-weighting filtering on the spectrum results in a decreased A-weighted sound level. For unweighted overall sound levels, the Doppler effect does not change the levels since all frequencies are accounted for equally.

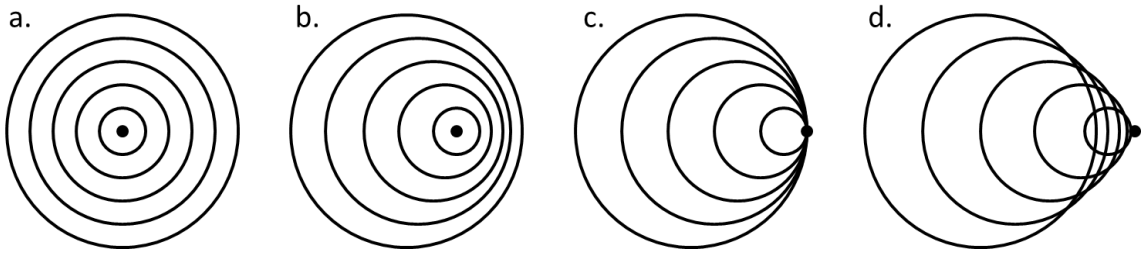

Figure 7. Effect of expanding wavefronts (decrease in frequency) that an observer would notice for higher relative speeds of the rocket relative to the observer for: a) stationary source b) source velocity < speed of sound c) source velocity = speed of sound d) source velocity > speed of sound

4.1.2 Propagation

The sound propagation from the source to receiver considers the ray path, atmospheric absorption, and ground interference.

Ray Path

The model assumes straight line propagation between the source and receiver to determine propagation effects. For straight rays, sound levels decrease as the sound wave propagates away from a source uniformly in all directions. The launch vehicle noise model components are calculated based on the specific geometry between source (launch vehicle trajectory point) to receiver (grid point). The position of the launch vehicle, described by the trajectory, is provided in latitude and longitude, defined relative to a reference system (e.g. World Geodetic System 1984) that approximates the Earth's surface by an ellipsoid. The receiver grid is also described in geodetic latitude and longitude, referenced to the same reference system as the trajectory data, ensuring greater accuracy than traditional flat earth models.

Atmospheric Absorption

Atmospheric absorption is a measure of the sound attenuation from the excitation of vibration modes of air molecules. Atmospheric absorption is a function of temperature, pressure, and relative humidity of the air. The propulsion noise model utilizes an atmospheric profile, which describes the variation of temperature, pressure, and relative humidity with respect to the altitude. Standard atmospheric data sources [35, 36, 37, 38] were used to create a composite atmospheric profile for altitudes up to 66 miles. The atmospheric absorption is calculated using formulas found in ANSI Standard S1.26-1995 (R2004). The result is a sound-attenuation coefficient, which is a function of frequency, atmospheric conditions, and distance from the source. The amount of absorption depends on the parameters of the atmospheric layer and the distance that the sound travels through the layer. The total sound attenuation is the sum of the absorption experienced from each atmospheric layer.

Nonlinear propagation effects can result in distortions of high-amplitude sound waves [39] as they travel through the medium. These nonlinear effects are counter to the effect of atmospheric absorption [40, 41]. However, recent research shows that nonlinear propagation effects change the perception of the received sound [42, 43], but the standard acoustical metrics are not strongly influenced by nonlinear effects [44, 45]. The overall effects of nonlinear propagation on high-amplitude sound signatures and their perception is an ongoing area of research, and it is not currently included in the propagation model.

Ground Interference

The calculated results of the sound propagation using DSM-1 provide a free-field sound level (i.e. no reflecting surface) at the receiver. However, sound propagation near the ground is most accurately modeled as the combination of a direct wave (source to receiver) and a reflected wave (source to ground to receiver) as shown in Figure 6. The ground will reflect sound energy back toward the receiver and interfere both constructively and destructively with the direct wave. Additionally, the ground may attenuate the sound energy, causing the reflected wave to propagate a smaller portion of energy to the receiver. RUMBLE accounts for the attenuation of sound by the ground [46, 47] when estimating the received noise. The model assumes a five-foot receiver height and a homogeneous grass ground surface. However, it should be noted that noise levels may be 3 dB louder over water surfaces compared to the predicted levels over the homogeneous grass ground surfaces assumed in the modeling. To account for the random fluctuations of wind and temperature on the direct and reflected wave, the effect of atmospheric turbulence is also included [46, 48].

4.1.3 Receiver

The received noise is estimated by combining the source and propagation components. The basic received noise is modeled as overall and spectral level time histories. This approach enables a range of noise metrics relevant to environmental noise analysis to be calculated and prepared as output.

4.2 Sonic Boom Modeling

A vehicle creates sonic booms during supersonic flight. The potential for the boom to intercept the ground depends on the trajectory and speed of the vehicle as well as the atmospheric profile. The sonic boom is shaped by the physical characteristics of the vehicle and the atmospheric conditions through which it propagates. These factors affect the perception of a sonic boom. The noise is perceived as a deep boom, with most of its energy concentrated in the low frequency range. Although sonic booms generally last less than one second, their potential for impact may be considerable.

A brief sonic boom generation and propagation modeling primer is provided in Section 4.2.1 to describe relevant technical details that inform the sonic boom modeling. The primer also provides visualizations of the boom generation, propagation, and ground intercept geometry. An overview of the sonic boom modeling software used in the study, PCBoom, and a description of inputs are found in Section 4.2.2.

4.2.1 Primer

When a vehicle moves through the air, it pushes the air out of its way. At subsonic speeds, the displaced air forms a pressure wave that disperses rapidly. At supersonic speeds, the vehicle is moving too quickly for the wave to disperse, so it remains as a coherent wave. This wave is a sonic boom. When heard at ground level, a sonic boom consists of two shock waves (one associated with the forward part of the vehicle, the other with the rear part) of approximately equal strength. When plotted, this pair of shock waves and the expanding flow between them has the appearance of a capital letter "N," so a sonic boom pressure wave is usually called an "N-wave." An N-wave has a characteristic "bang-bang" sound that can be startling. Figure 8 shows the generation and evolution of a sonic boom N-wave under the vehicle.

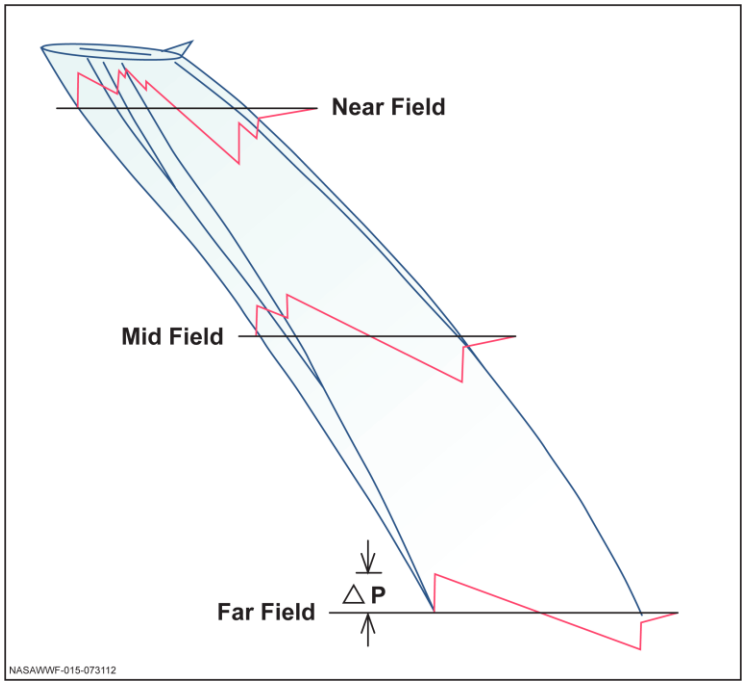

Figure 8. Sonic boom generation and evolution to N-wave [49]

For aircraft, the front and rear shock are generally the same magnitude. However, for rockets, in addition to the two shock waves generated from the vehicle body, the plume itself acts as a large supersonic body, and it generates two additional shock waves (one associated with the forward part of the plume, the other with the rear part) and extends the waveform duration to as large as one second. If the plume volume is significantly larger than the vehicle, its shocks will be stronger than the shocks generated by the vehicle.

Figure 9 shows the sonic boom wave cone generated by a vehicle in steady (non-accelerating) level supersonic flight. The wave cone extends toward the ground and is said to sweep out a "carpet" under the flight track. The boom levels vary along the lateral extent of the "carpet" with the highest levels directly underneath the flight track and decreasing levels as the lateral distance increases to the cut-off edge of the "carpet."

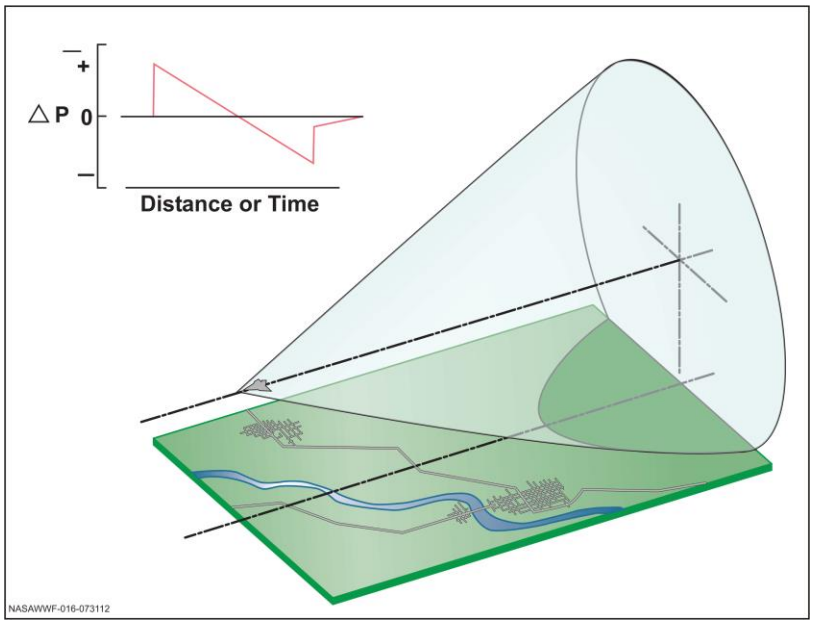

Figure 9. Sonic boom carpet for a vehicle in steady flight [50]

Although the wave cone can be calculated from an aircraft-fixed reference frame, the ray perspective is more convenient when computing sonic boom metrics in a ground-fixed observer's reference frame [51]. Both perspectives are shown in Figure 10. The difference in wave versus ray perspectives is described for level, climbing, and diving flight, in the PCBoom Sonic Boom Model User Guide [51]:

> Sonic boom wave cones are not generated fully formed at a single point in time, instead resulting from the accumulation of all previous disturbance events that occurred during the vehicle's time history. […] Unlike wave cones, ray cones are fully determined at a single point in time and are independent of future maneuvers. They are orthogonal to wave cones and represent all paths that sonic boom energy will take from the point they are generated until a later point in time when they hit the ground. The ray perspective is particularly useful when considering refraction due to atmospheric gradients or the effect of aircraft maneuvers, where rays can coalesce into high amplitude focal zones.

When the ray cone hits the ground, the resulting intersection is called an "isopemp." The isopemp is forward-facing [as shown in Figure 10] and falls a distance ahead of the vehicle called the "forward throw." At each new point in the trajectory, a new ray cone is generated, resulting in a new isopemp that strikes the ground. These isopemps are generated throughout the trajectory, sweeping out an area called the "boom footprint."

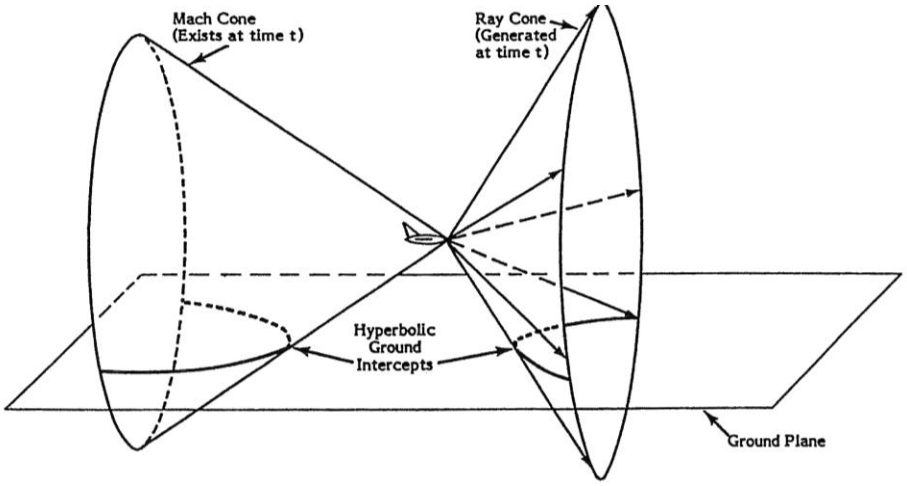

Figure 10. Mach cone vs ray cone viewpoints

Figure 9 and Figure 10 may give the impression that the boom footprint is generally associated with rays generated from the bottom of a vehicle. This is the case for vehicles at moderate climb and dive angles, or in level flight as shown in Figure 10. For a vehicle climbing at an angle steeper than the ray cone half angle, such as in the left image of Figure 11, rays from that part of its trajectory will not reach the ground. This is important for vertical launches, where the ascent stage of a launch vehicle typically begins at a steep angle. In these cases, sonic booms are not expected to reach the ground unless refracted back downwards by gradients in the atmosphere. Conversely, if a vehicle is in a sufficiently steep dive, such as in the right image of Figure 11, the entire ray cone may intersect the ground, resulting in an elliptical or even circular isopemp. This is of importance for space flight reentry analysis, where descent may be nearly vertical.

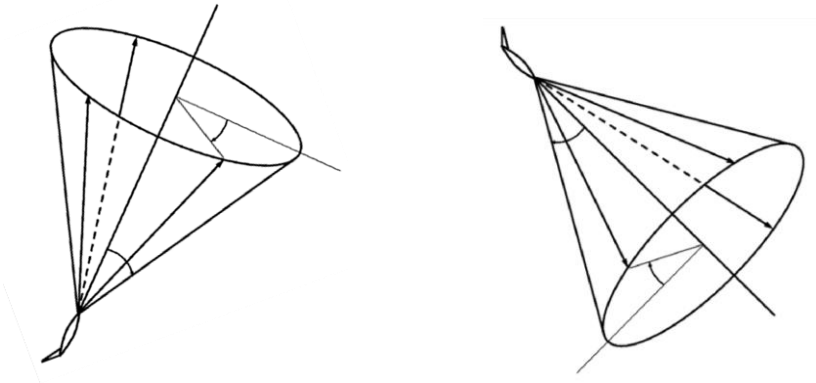

Figure 11. Ray cone in climbing (left) and diving (right) flight

4.2.2 PCBoom

The single-event prediction model, PCBoom [52, 53, 54], is a full ray trace sonic boom program that is used to calculate the magnitude, waveform, and location of sonic boom overpressures on the ground from supersonic flight operations. Additionally, PCBoom accounts for the effect of rocket exhaust plumes on the boom [55].

Several inputs are required to calculate the sonic boom impact, including the geometry of the vehicle, the trajectory path, and the atmospheric conditions. These parameters along with time-varying thrust, drag, and weight are used to define the PCBoom starting signatures used in the modeling. The starting signatures are propagated through a site-specific atmospheric profile that includes the mean temperature, wind speed, and wind direction [56].

5 Results

The following sections present the results of the environmental propulsion noise and sonic boom impacts associated with the proposed Vulcan Centaur operations. Note, noise levels over water may be higher because of the acoustical hardness of the water surface. Single event and cumulative launch vehicle noise results are presented in Section 5.1 and Section 5.2, respectively.

5.1 Single Event Noise

Single event propulsion noise and sonic boom modeling results are presented in Sections 5.1.1 and 5.1.2, respectively.

5.1.1 Propulsion Noise

Individual launch site operations are evaluated using maximum A-weighted and unweighted sound levels for propulsion noise.

Maximum A-weighted Sound Level ($L_{A,max}$)

The modeled $L_{A,max}$ contours associated with the Vulcan Centaur launch operations at VAFB SLC-3 facility are presented in Figure 12. An upper limit noise level of 115 dBA is used as a guideline to protect human hearing from long-term continuous daily exposures to high noise levels and to aid in the prevention of NIHL. The Vulcan Centaur launch event generates modeled levels at or above an $L_{A,max}$ of 115 dBA within 0.7 miles of the launch site. The 115 dBA contour associated with the Vulcan Centaur launch is entirely within the boundaries of VAFB. Thus, the potential for impacts to people in the community with regards to hearing conservation is negligible.

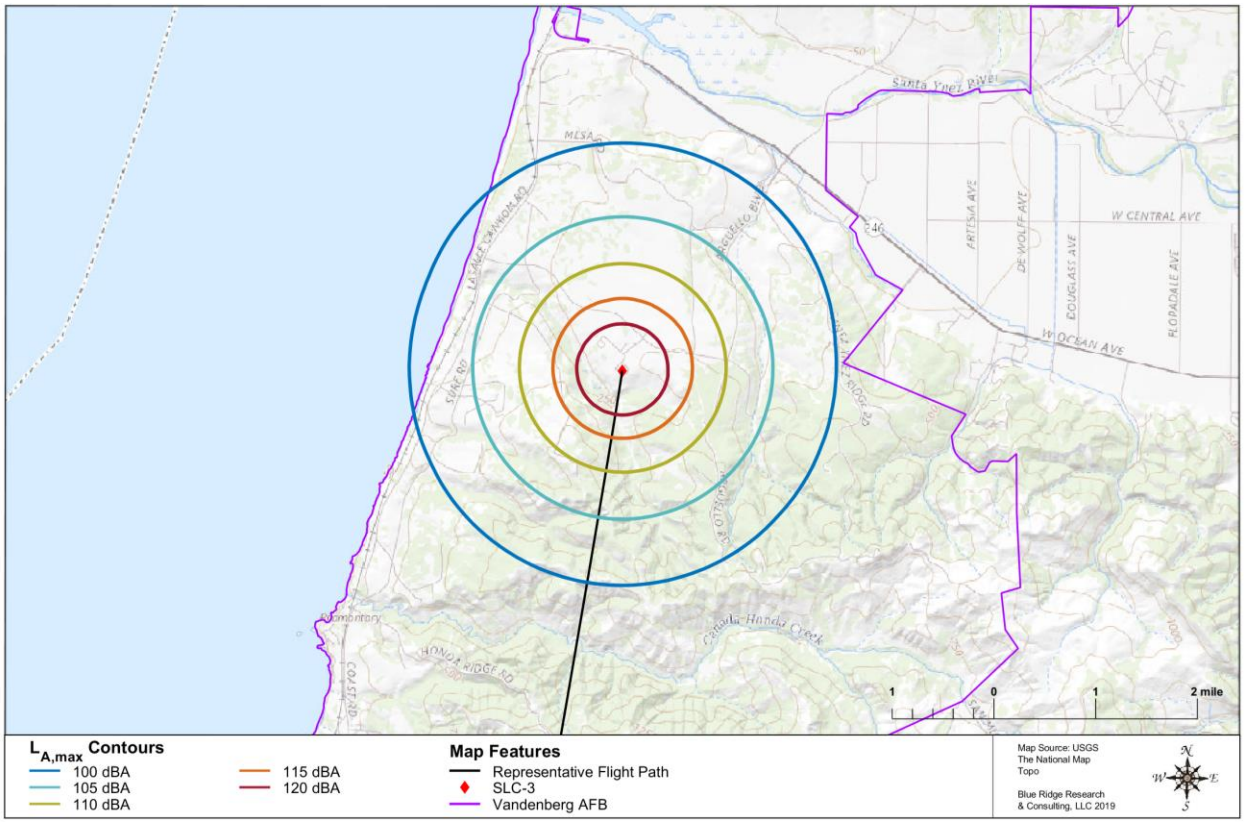

Figure 12. $L_{A,max}$ contours for the Vulcan Centaur (composed of a single Vulcan core and six GEM-63XL strap-on SRB's) launch from VAFB SLC-3

Maximum Unweighted Sound Level (L_{max})

The modeled L_{max} contours associated with the Vulcan Centaur launch operations from VAFB SLC-3 facility are presented in Figure 13. For reference, the potential for structural damage claims is approximately one damage claim per 100 households exposed at 120 dB and one in 1,000 households at 111 dB [21]. For the Vulcan Centaur launch event, the modeled 120 dB and 111 dB L_{max} contours are limited to radii of 4.4 miles and 11.1 miles from the launch site, respectively. The majority of the land area encompassed by the 120 dB noise contours lie within VAFB boundaries, with the exception of farmland west of Lompoc. The land area between the 111 dB and 120 dB noise contours include the communities of Lompoc, Mission Hills, and Vandenberg Village. Also included within the 111 dB noise contours are portions of La Purisima Mission State Historic Park.

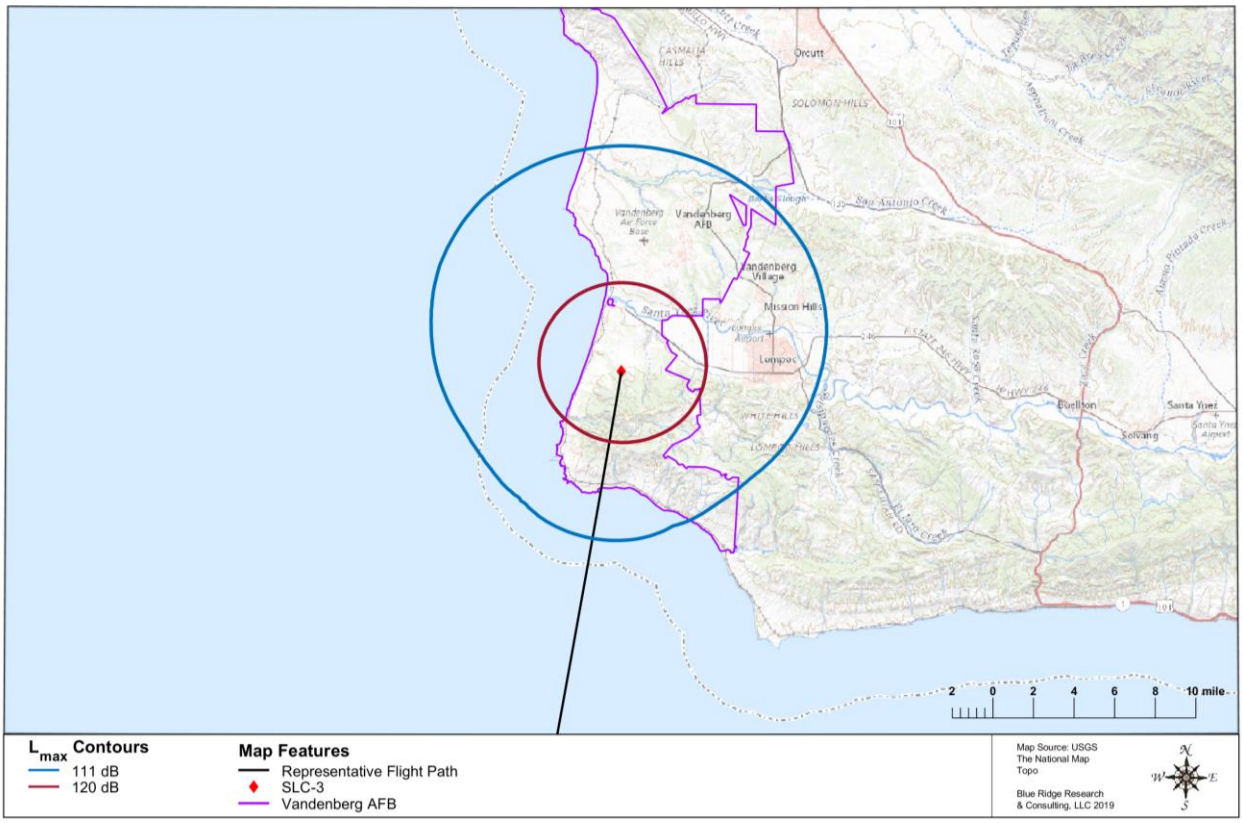

Figure 13. L_{max} contours for the Vulcan Centaur (composed of a single Vulcan core and six GEM-63XL strap-on SRB's) launch from VAFB SLC-3

5.1.2 Sonic Booms

Individual launch site operations are evaluated using maximum peak overpressure for sonic booms.

Maximum Peak Overpressure (psf)

The sonic boom peak overpressure contours for the modeled Vulcan Centaur launch operations are presented in Figure 14. The sonic boom footprint produced by the Vulcan Centaur launch vehicle has a long, narrow, forward-facing, crescent-shaped focus boom region beginning 42 miles downrange of the launch site. The focus boom region is generated because the launch vehicle continuously accelerates and pitches downward as it ascends. The maximum peak overpressure along the focus boom region is predicted to be approximately 10.4 psf. However, these high levels would only occur in extremely small areas along the focus boom region. As the rocket gains altitude, the sonic boom peak overpressure gradually decreases, and the crescent-shaped contours become slightly wider.

The sonic booms were modeled based on a single launch trajectory at a nominal azimuth of 188° relative to true north. A site-specific atmospheric profile that includes winds was used to propagate the starting signatures to the ground. The sonic boom peak overpressure contours for the modeled Vulcan Centaur launch operation are predicted to be almost entirely over water. However, the exact location of the sonic boom footprint produced by each Vulcan Centaur launch operation will be highly dependent on the vehicle configuration, trajectory, and atmospheric conditions at the time of flight. If the trajectory azimuth

is closer to due south, there is an increased potential that the northern Channel Islands may be impacted by the sonic boom footprint.

A summary of the results for the modeled Vulcan Centaur launch operation is provided below:

- The focus boom region begins downrange of the northern Channel Islands of San Miguel, Santa Rosa, Santa Cruz, and Anacapa. Thus, these islands are not predicted to experience sonic booms based on the modeled launch trajectory of the Vulcan Centaur.
- Sonic booms with peak overpressures of 0.5 psf and above, including the focus boom regions, are predicted to occur exclusively over water.
- Low-level sonic booms of approximately 0.25 psf (not shown in Figure 14), comparable to distant thunder, may be experienced on parts of San Nicolas Island.

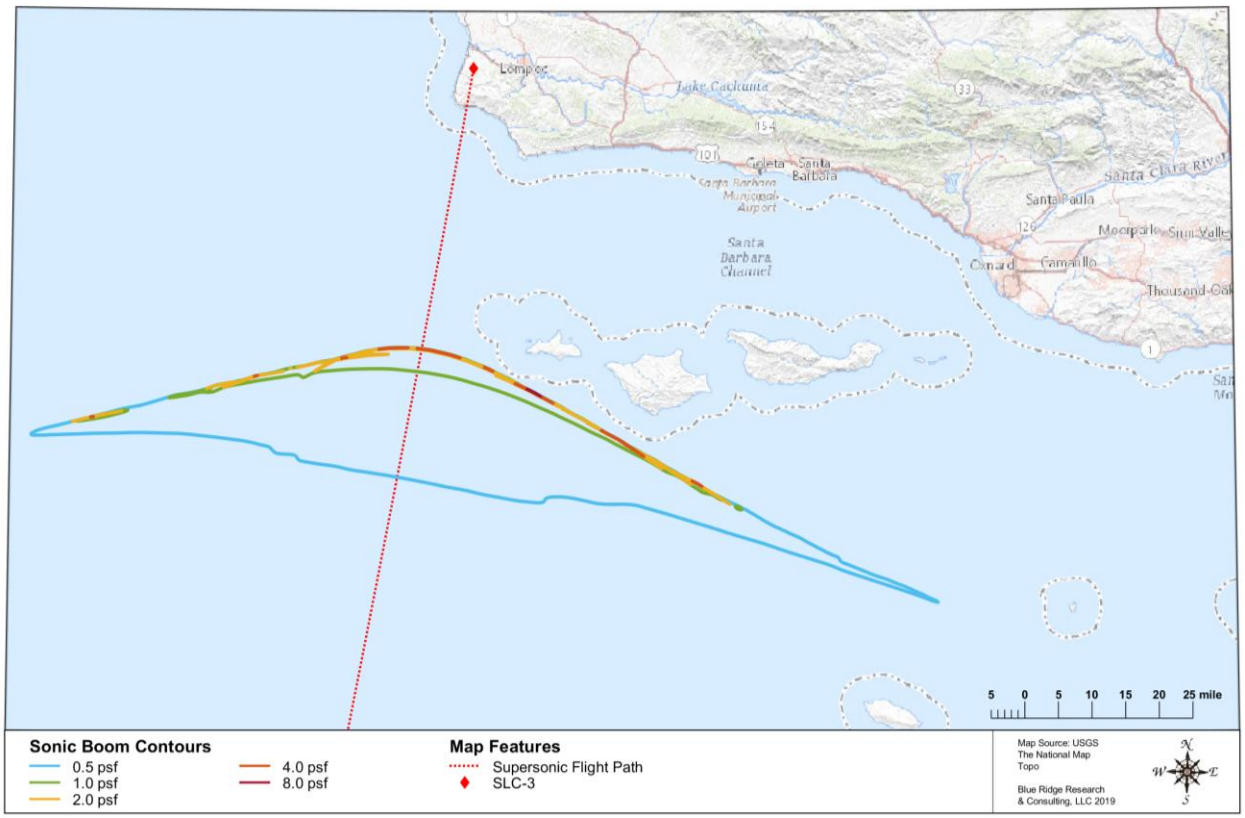

Figure 14. Sonic boom peak overpressure contours for a nominal Vulcan Centaur launch from SLC-3

The only structures exposed to the modeled sonic boom footprint are those at the US Naval Outlying Landing Field San Nicolas Island, which may experience sonic boom peak overpressures of approximately 0.25 psf. However, the potential for structural damage is unlikely at levels less than 2 psf. Thus, the potential for structural damage due to sonic booms is extremely unlikely. The potential for hearing damage (with regards to humans) is also extremely unlikely, as the modeled sonic boom peak overpressure levels over land are significantly lower than the approximately 4-psf impulsive hearing conservation noise criteria.

Although the proposed launch operations do not pose significant impacts in relation to human annoyance, hearing conservation, or structural damage; the unexpected, loud impulsive noise of sonic booms tend to cause a startle effect in people. However, when humans are exposed to impulse noises with similar characteristics on a regular basis, they tend to become conditioned to the stimulus and the resulting startle reaction is generally not displayed. The physiological effects of single sonic booms on humans [56] for the levels produced by the Vulcan Centaur can be grouped as presented in Table 4.

Table 4. Physiological effects of single sonic booms on humans [56]

Overpressure	Behavioral effects
0.3 psf	Orienting, but no startle response; eyeblink response in 10% of subjects; no arm/hand movement.
0.6 – 2.3 psf	Mixed pattern of orienting and startle responses; eyeblink in about half of subjects; arm/hand movements in about a fourth of subjects, but not gross bodily movements.
2.7 – 6.5 psf	Predominant pattern of startle responses; eyeblink response in 90% of subjects; arm/hand movements in more than 50% of subjects with gross body flexion in about a fourth of subjects.
7.1 – 13.3 psf	Arm/hand movements in more than 90% of subjects.

To provide perspective, the modeled results are compared to measured sonic boom peak overpressure levels produced by similar launch vehicles from VAFB. The sonic boom produced by the launch of a Titan IV from Vandenberg AFB was measured at a number of locations in the Channel Islands at distances 30 to 40 miles from the launch pad [57]. The peak overpressures recorded at these locations were less than 2.4 psf, except at one site, which recorded a focused sonic boom of 8.4 psf. The maximum modeled peak overpressure for the modeled Vulcan Centaur launch operations (10.4 psf) is slightly higher than the Titan IV measurement, but the focus boom region is predicted to occur exclusively over water.

5.2 Cumulative Noise

The potential for long-term community annoyance is assessed using A-weighted CNEL for launch vehicle noise and C-weighted CNEL for sonic booms.

Launch Site Operations

As CNEL contours representing the no action alternative at VAFB are unavailable, an alternative technique is used to identify the potential for significant noise impacts. The CNEL 60 dBA contour is used to conservatively identify the potential for significant noise impacts, as 60 dBA is the smallest level that could "increase noise by [CNEL] 1.5 dB[A] or more for a noise sensitive area that is exposed to noise at or above the [CNEL] 65 dB[A] noise exposure level, or that will be exposed at or above this level due to the increase" [11]. The CNEL contours from 60 dBA to 85 dBA are presented in Figure 15. The CNEL 65 and 60 dBA contours extend approximately 0.7 and 1.2 miles from the launch pad, respectively. This area does not encompass land outside of the boundary of VAFB, and, thus, no residences are impacted.

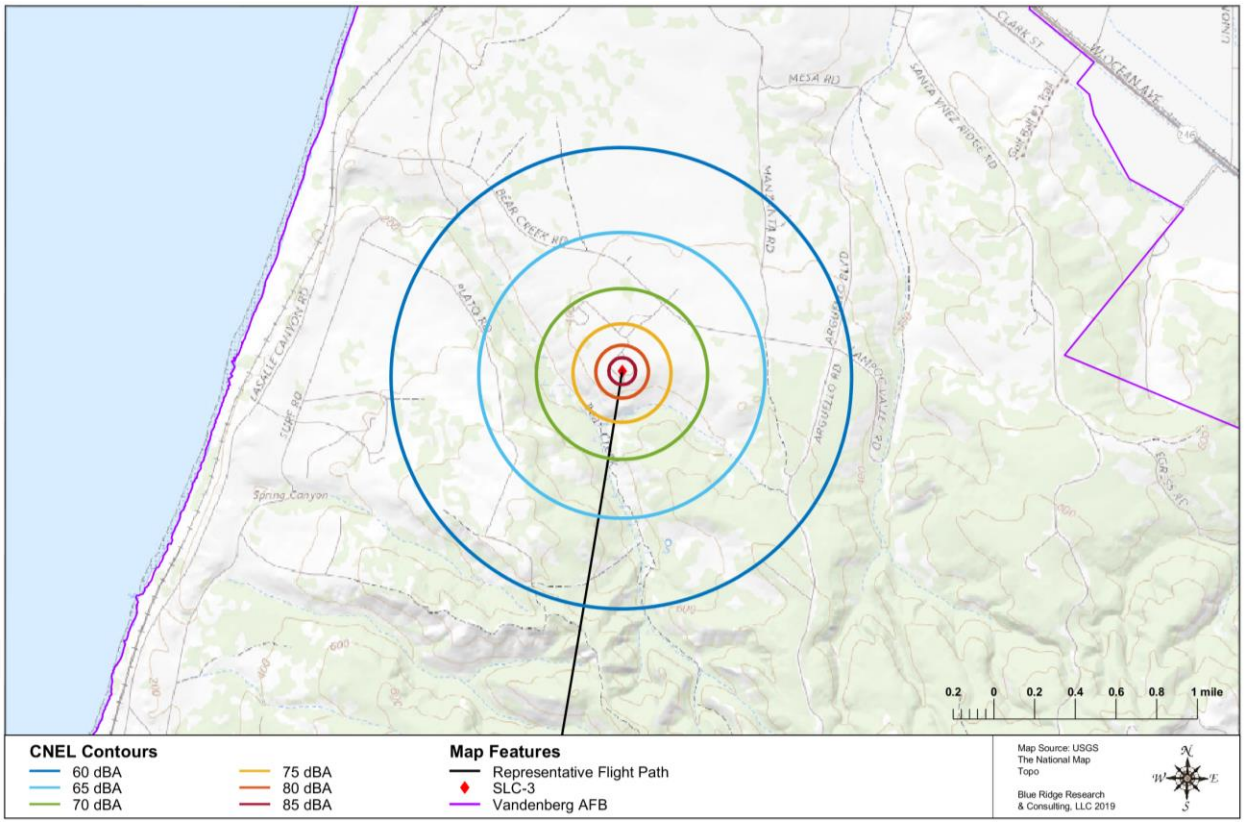

Figure 15. CNEL contours for the Vulcan Centaur (composed of a single Vulcan core and six GEM-63XL strap-on SRB's) launch from VAFB SLC-3

The presence and/or location of sonic booms from Vulcan Centaur launches will be highly dependent on the vehicle configuration, trajectory, and atmospheric conditions at the time of flight. However, the sonic booms resulting from the modeled launch trajectory would occur almost entirely over water, with low-level (0.25-psf) peak overpressures predicted for parts of San Nicolas Island. Therefore, with respect to human annoyance, health and safety, or structural damage, noise impacts due to sonic booms for the launch trajectory are not expected. Thus, a quantitative CNEL analysis was not performed.

6 Summary

This report documents the noise study performed as part of ULA's efforts on the EA for the proposed Vulcan Centaur operations from VAFB. ULA plans to conduct launch operations of multiple Vulcan Centaur configurations from VAFB SLC-3. The most powerful configuration, composed of a single Vulcan core and six GEM-63XL strap-on SRB's, will be modeled to determine the envelope of the potential noise impacts. Noise impacts were evaluated for a nominal launch trajectory for up to six annual launches per year. The potential impacts from propulsion noise and sonic boom are evaluated on a single-event and cumulative basis in relation to hearing conservation, structural damage, and human annoyance.

Single Event Noise Results with respect to Hearing Conservation

An upper limit noise level of $L_{A,max}$ 115 dBA is used as a guideline to protect human hearing from long-term continuous daily exposures to high noise levels and to aid in the prevention of NIHL. The 115 dBA contour associated with the Vulcan Centaur launch is entirely within the boundary of VAFB.

For impulsive noise events such as sonic booms, noise impacts to human annoyance and health and safety are not expected. Thus, the potential for impacts to people in the community with regards to hearing conservation is negligible.

Single Event Noise Results with respect to Structural Damage

The potential for structural damage claims is approximately one damage claim per 100 households exposed at 120 dB and one in 1,000 households at 111 dB [21]. The majority of the land area encompassed by the 120 dB noise contours lie within VAFB boundaries, with the exception of farmland west of Lompoc. The land area between the 111 dB and 120 dB noise contours include the communities of Lompoc, Mission Hills, and Vandenberg Village. Also included within the 111 dB noise contours are portions of La Purisima Mission State Historic Park.

For impulsive events such as sonic booms, levels greater than 2 psf indicate potential for structural damage (to glass, plaster, roofs, and ceilings) for well-maintained structures. Modeled sonic boom peak overpressure levels above 2 psf occur entirely over water based on the modeled launch trajectory of the Vulcan Centaur. Thus, the potential for impacts with regards to structural damage is negligible.

Cumulative Noise Results

The CNEL 60 dBA contour is used to conservatively identify the potential for significant noise impacts. The area identified within the 60 dBA contour for cumulative noise does not encompass land outside of the boundary of VAFB, and, thus, no residences are impacted.

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