Environmental Impact Statement

Regional Special Use Airspace Optimization to Support Air Force Missions in Arizona

Draft

August 2024

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This Draft Environmental Impact Statement (EIS) has been provided for public comment in accordance with the National Environmental Policy Act (NEPA), Council on Environmental Quality NEPA Implementing Regulations (Title 40 Code of Federal Regulations [CFR] Parts 1500 - 1508), and 32 CFR Part 989, Environmental Impact Analysis Process (EIAP). EIAP provides an opportunity for public input on United States Department of the Air Force (DAF) decision-making, allows the public to offer input on alternative ways for DAF to accomplish what it is proposing, and solicits comments on DAF's analysis of environmental effects.

Public input allows DAF to make better-informed decisions. Letters or other written or verbal comments provided may be published in this EIS. Providing personal information is voluntary. Private addresses will be compiled to develop a stakeholders inventory. However, only the names of the individuals making comments and specific comments will be disclosed. Personal information, home addresses, telephone numbers, and email addresses will not be published in this EIS.

The digital version of this EIS and its project website are compliant with Section 508 of the Rehabilitation Act of 1973 because assistive technology (e.g., "screen readers") can be used to help the disabled to understand these electronic media. Due to the nature of graphics, figures, tables, and images occurring in the document, accessibility may be limited to a descriptive title for each item.

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ENVIRONMENTAL IMPACT STATEMENT
REGIONAL SPECIAL USE AIRSPACE OPTIMIZATION
TO SUPPORT AIR FORCE MISSIONS IN ARIZONA

August 2024

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Cover Sheet
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ENVIRONMENTAL IMPACT STATEMENT
REGIONAL SPECIAL USE AIRSPACE OPTIMIZATION
TO SUPPORT AIR FORCE MISSIONS IN ARIZONA

a. *Responsible and Cooperating Agencies:* United States Department of the Air Force (DAF) (Responsible Agency); the Federal Aviation Administration (FAA), National Park Service, United States Forest Service, and Arizona Game and Fish Department are Cooperating Agencies.

b. *Title of Action:* Regional Special Use Airspace Optimization to Support Air Force Missions in Arizona

c. *Comments and Inquiries:* Ms. Grace Keesling, AFCEC/CIE at (210) 925-4534

d. *Designation:* Draft Environmental Impact Statement (EIS)

e. *Abstract:* This Draft EIS has been prepared in accordance with the National Environmental Policy Act (NEPA). The public and agency scoping process resulted in the analysis of the following environmental resources: airspace management and use; safety; noise; air quality; natural resources; land management and recreation; socioeconomics; environmental justice; cultural resources; hazardous materials; and visual effects. The DAF proposes to alleviate training shortfalls and address evolving training needs for aircrews stationed at Davis-Monthan Air Force Base, Luke Air Force Base, and Morris Air National Guard Base in Arizona by requesting that the FAA implement modifications to existing DAF-managed training airspace. The Proposed Action includes changing the published times of use for training airspace; adjusting the horizontal dimensions of some airspace; lowering the floor of some airspace to allow for low-altitude training; and adjusting the attributes to allow for supersonic speed at lower altitude, use of chaff, and lowering the release altitude for flares. This Draft EIS analysis was started prior to the decision to retire A-10 aircraft, which was enabled by adoption of the Fiscal Year 2023 Presidential Budget and passing of the 2024 National Defense Authorization Act. Thus, this Draft EIS includes A-10 operations.

f. *Comments:* The DAF released this Draft EIS to the public and agencies for review and comment. A Notice of Availability was published in the Federal Register, newspaper advertisements were published, press releases were announced, notifications were distributed to individuals on the mailing list, and letters accompanied the direct mailing of this Draft EIS document. This Draft EIS has been posted on a publicly accessible website at www.arizonaregionalairspaceeis.com. Copies of this Draft EIS document were also sent to local document repositories.

The Draft EIS public comment period must be a minimum of 45 days beginning on the Notice of Availability publication date in the Federal Register. All substantive comments received prior to the close of the public comment period will be considered during preparation of the Final EIS. The DAF responds to substantive comments on a Draft EIS in the Final EIS, consistent with 40 Code of Federal Regulations Section 1503.4. Substantive comments are regarded as those comments that challenge the analysis, methodologies, or information in the Draft EIS as being factually inaccurate or analytically inadequate; identify impacts not analyzed or identify reasonable alternatives or feasible mitigations not considered by the agency; or offer specific information that may have a bearing on the decision such as differences in interpretations of significance, scientific data, or technical conclusions. Non-substantive comments, which do not require a DAF response, are generally considered those comments that express a conclusion, an opinion, or a vote for or against the proposal itself, or some aspect of it; state a position for or against a particular alternative; or otherwise state a personal preference or opinion.

g. *Time Extension*: DAF's Senior Agency Official responsible for NEPA execution has approved a timeline extension beyond the 2 years stipulated in 40 Code of Federal Regulations Section 1501.10 for completion of this EIS and Record of Decision.

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ENVIRONMENTAL IMPACT STATEMENT FOR REGIONAL SPECIAL USE AIRSPACE OPTIMIZATION TO SUPPORT AIR FORCE MISSIONS IN ARIZONA

TABLE OF CONTENTS

List of Figures

List of Tables

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1.0 PURPOSE OF AND NEED FOR THE PROPOSED ACTION

1.1 INTRODUCTION

The Department of the Air Force (DAF[1]) is proposing to alleviate training shortfalls and address evolving training needs for aircrews stationed at Davis-Monthan Air Force Base (AFB), Luke AFB, and Morris Air National Guard Base (ANGB) in Arizona by requesting that the Federal Aviation Administration (FAA) implement modifications to existing DAF-managed ***Military Operations Areas (MOAs[2])***, which are a type of ***Special Use Airspace (SUA),*** and associated ***Air Traffic Control Assigned Airspace (ATCAA).*** The bases in Arizona share a primary mission to train and deploy combat-ready pilots for the Air Force, Air National Guard (ANG), and Air Force Reserves, thus the DAF-managed MOAs in this region must support training for a variety of aircraft and missions. Much of the DAF-managed MOAs available to aircrews in this region were first charted decades ago and minimal improvements have been made over time in response to changes to the DAF aircraft inventory, new training requirements, or expanded missions. Thus, there is a need to optimize existing MOAs and ATCAAs by modifying the published times of use, volume, minimum altitude for supersonic flight, use of ***chaff***, and lowering the release altitude for ***flares*** to ensure availability of appropriate airspace to accomplish essential training requirements for aircrews stationed in Arizona.

A MOA is used for more active military flying than just transiting an area, such as air combat maneuvers, air intercepts, and low-altitude tactics, and may employ chaff and flares, or supersonic flight. Because those types of activities need to be separated from non-military aviation, they are only conducted within MOAs designated by the FAA. The existing DAF-managed MOAs have limited capacity to support low-altitude and supersonic operations at lower altitudes, which are components of several mission training requirements for the primary fighter aircraft based in Arizona (A-10, F-16, and F-35). Because of this, certain aspects of training are either curtailed, delayed, or restructured to occur over several training events which requires more time, a greater cost, and results in reduced quality of training. Restructuring training to occur over multiple events removes the realism from an individual training scenario reducing the quality of training the pilot receives (see **Section 1.3.1** for additional information).

The FAA processes requests for the establishment or modification of MOAs in accordance with procedures defined in FAA Order JO 7400.2P, *Procedures for Handling Airspace Matters*. The process for establishing (or modifying) MOAs is two-fold, comprising both aeronautical and environmental analyses. The DAF will submit a formal airspace proposal to the FAA defining the proposed MOAs. The FAA is responsible for the safe and efficient use of navigable airspace and ensures the proposed MOAs are compliant with airspace regulations and circulates the airspace proposal for public review. In addition to the aeronautical analysis, the FAA has participated in this Environmental Impact Statement (EIS) as a cooperating agency. The FAA may or may not adopt this EIS, in whole or in part, to comply with their National Environmental Policy Act (NEPA) procedures defined in FAA Order 1050.1F, *Environmental Impacts: Policies and Procedures*, and Chapter 32 of FAA Order JO 7400.2P, *Procedures for Handling*

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[1] **Appendix A** includes a list of all acronyms and abbreviations used in this EIS.

[2] In compliance with 40 Code of Federal Regulations (CFR) 1500.4, *Reducing paperwork*, a glossary is provided in **Appendix B** of this EIS that provides definitions and additional details for the technical terminology used throughout this EIS in lieu of adding this information to the narrative in the main body of the EIS. Terms included in the glossary are shown in ***bold*** the first time they are used in the narrative sections of the EIS.

Airspace Matters, prior to making a decision to chart any proposed MOA addressed in this EIS. If approved, the new MOAs would be published in the current issue of FAA Order JO 7400.10, *Special Use Airspace*, and illustrated on sectional aeronautical charts, at which time they would be available for use as defined in this EIS. The MOAs associated with the Proposed Action and alternatives lie within the jurisdiction of the FAA Albuquerque Air Route Traffic Control Center (Albuquerque Center).

This EIS was prepared in compliance with the NEPA of 1969 (42 United States [U.S.] Code [USC] 4331 et seq.), the regulations of the President's Council on Environmental Quality (CEQ) NEPA implementing procedures (40 Code of Federal Regulations [CFR] 1500–1508), the Air Force Environmental Impact Analysis Process promulgated at 32 CFR 989, and FAA Order 1050.1F, *Environmental Impacts: Policies and Procedures*. This EIS was completed through the Air Force Civil Engineer Center NEPA Division in coordination with the Headquarters U.S. Air Force Operations, Plans, and Requirements, Air Combat Command (ACC), Air Education and Training Command (AETC), National Guard Bureau, FAA, Davis-Monthan AFB, Luke AFB, and Morris ANGB. DAF bases in Arizona associated with this Proposed Action and the Barry M. Goldwater Range (BMGR) are described in the following sections.

1.1.1 Davis-Monthan AFB

Davis-Monthan AFB, located in Tucson, Arizona, is an ACC base home to the 355th Wing (355 WG), responsible for training and deploying A-10 pilots. In addition to the fighter training mission, the base is also home to the 563rd Rescue Group, which is an active-duty rescue group dedicated to combat search and rescue. Several flying units are assigned to the base, contributing to a varied aircraft inventory that includes, but is not limited to, A-10s, EC-130Hs, HC-130Js, and HH-60Gs. Libby Army Airfield located southeast of Davis-Monthan AFB at Sierra Vista Municipal Airport is the designated Air Force Auxiliary Airfield for Davis-Monthan AFB and Morris ANGB. This Draft EIS analysis was started prior to the decision to retire A-10 aircraft, which was enabled by adoption of the Fiscal Year 2023 Presidential Budget and passing of the 2024 National Defense Authorization Act. Thus, this Draft EIS analysis includes A-10 operations to reflect the highest possible utilization of DAF-managed SUA associated with this EIS. A-10 retirement at Davis-Monthan AFB could occur as early as Fiscal Year 2026. Future missions proposed for Davis-Monthan AFB and associated use of regional SUA as charted would be analyzed in separate NEPA analysis, as necessary.

1.1.2 Morris ANGB

Morris ANGB, located at Tucson International Airport in Tucson, Arizona, is home to the 162nd Wing (162 WG), which is an F-16 fighter pilot training unit for the DAF and international partners. The 162 WG mission is to maintain well-trained, well-equipped units for prompt mobilization during war and assistance during national emergencies. The 162 WG consists of a fleet of more than 80 F-16s. The 162 WG trains F-16 pilots from 23 different countries, while developing strategic partnerships and building strong international relationships.

1.1.3 Luke AFB

Luke AFB, located approximately 15 miles west of Phoenix, Arizona, is an AETC base home to the 56th Fighter Wing (56 FW). The 56 FW mission is to train fighter pilots and combat-ready airmen. By 2025, the 56 FW is projected to operate 144 F-35s and 26 F-16s (DAF 2012). The 56th Range Management Office (56 RMO) operates the BMGR East and its associated restricted areas, R-2301E, R-2304, and R-2305, and the Gila Bend Air Force Auxiliary Field.

1.1.4 Barry M. Goldwater Range

BMGR is one of the Nation's most capable and productive training ranges and is indispensable to the ability of the U.S. Armed Forces to produce combat-ready aircrews. While aircrew training is the predominant mission of the BMGR, the range is also vital for preparing other personnel and units that perform a variety of missions relevant to the air-ground battlefield. The range supports air-to-air, air-to-ground, and ground-to-ground live-fire training.

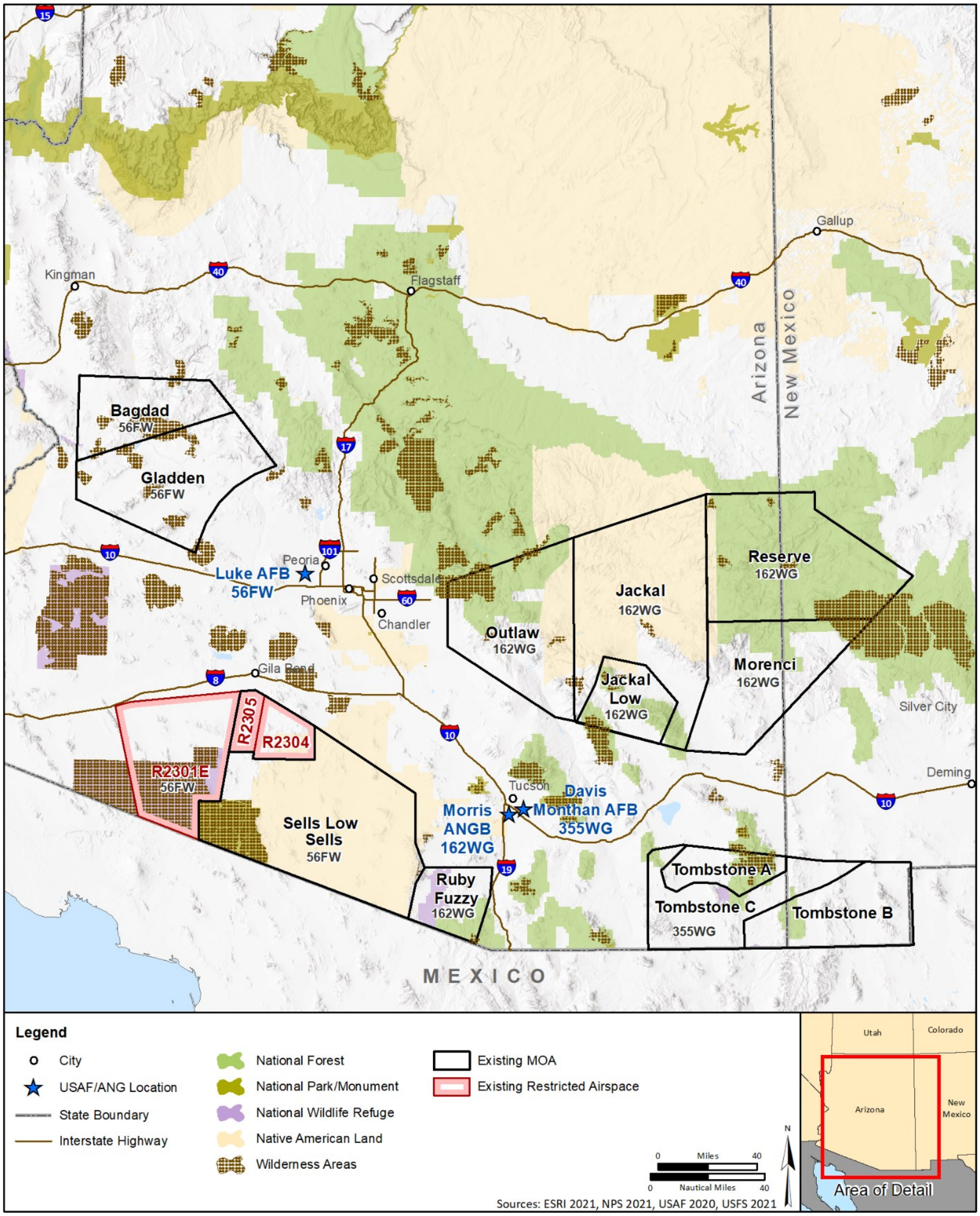
The BMGR, located in southwestern Arizona, consists of approximately 1.7 million acres and over 7,000 square miles of airspace. The DAF is the administrator and primary user of BMGR East, approximately 60 percent of the range, and the U.S. Marine Corps is the administrator and primary user of BMGR West, approximately 40 percent of the range. The 56 RMO at Luke AFB manages and operates BMGR East, while Marine Corps Air Station (MCAS) Yuma Range Management Department manages and operates BMGR West.

All references to BMGR herein refer to BMGR East and its associated DAF-managed airspace unless otherwise stated.

1.2 EXISTING AIRSPACE AND OPERATIONS

1.2.1 Existing Airspace

The DAF-managed SUA associated with this EIS includes the restricted areas and several MOAs and their associated ATCAAs that are located throughout Arizona and a small portion of western New Mexico (**Figure 1.2-1**). The parameters of the existing MOAs and ATCAAs are detailed in **Table 1.2-1.** Additional information on the existing MOAs and ATCAAs and detailed figures of each are provided in **Appendix C**. The DAF-managed restricted areas associated with BMGR East, R-2301E, R-2304, and R-2305 are shown on **Figure 1.2-1** for reference but no modifications are proposed to these areas because no changes are needed to the BMGR-related airspace. The BMGR restricted areas allow for training from the surface up to Flight Level (FL) 800 in R-2301E and up to FL240 in R-2304 and R-2305 and are authorized for several critical attributes: supersonic operations down to 5,000 feet mean sea level (MSL) (in R-2301E), and use of chaff and flares.



Legend: AFB = Air Force Base; ANG = Air National Guard; ANGB = Air National Guard Base; DAF = Department of Air Force; FW = Fighter Wing; MOA = Military Operations Area; WG = Wing.

Figure 1.2-1 DAF-Managed MOAs Proposed for Optimization

Table 1.2-1 Existing Parameters of Airspace Proposed for Optimization

MOA	Published Times of Use	Vertical Dimensions[1]	Chaff/Flares Authorized	Supersonic Operations	Associated ATCAA (altitudes)
Tombstone A	0600–2100 M–F; other times by NOTAM	500 feet AGL to 14,500 feet MSL	No/Yes	ATCAA only (above FL300)	Tombstone ATCAA (FL180-FL510)
Tombstone B		500 feet AGL to 14,500 feet MSL			
Tombstone C		14,500 feet MSL to FL180			
Outlaw	0700–1800 M–F 1800–2200 M–F by NOTAM Intermittent weekends by NOTAM	8,000 feet MSL or 3,000 feet AGL (whichever is higher) to FL180	Yes/Yes	ATCAA only (above FL300)	Outlaw ATCAA (FL180 to FL290)[2]
Jackal		11,000 feet MSL or 3,000 feet AGL (whichever is higher) to FL180	Yes/Yes	ATCAA only (above FL300)	Jackal ATCAA (FL180 to FL290)
Jackal Low		100 feet AGL to 11,000 feet MSL or 3,000 feet AGL (whichever is higher)	Yes/Yes	Not authorized	
Morenci	0600–2100 M–F; other times by NOTAM	1,500 feet AGL to FL180	Yes/Yes	ATCAA only (above FL300)	Morenci ATCAA (FL180 to FL510)
Reserve	By NOTAM	5,000 feet AGL to FL180	Yes/Yes	ATCAA only (above FL300)	Reserve A, B, C ATCAA (FL180 to FL510)
Bagdad	0600–1900 M–F; other times by NOTAM	7,000 feet MSL or 5,000 feet AGL (whichever is higher) to FL180	Yes/Yes	Above 10,000 feet MSL	Bagdad ATCAA (FL180-FL280)
Gladden	0600–1900 M–F; other times by NOTAM	7,000 feet MSL or 5,000 feet AGL (whichever is higher) to FL180	Yes/Yes	Above 10,000 feet MSL	Gladden ATCAA (FL180-FL510)
Sells	0600–1900 M–F; other times by NOTAM	10,000 feet MSL to FL180	Yes/Yes	Above 10,000 feet MSL	Sells A, B, C, D, E ATCAA (FL180-FL510) Sells A ATCAA above R-2304,R-2305 (FL250-FL510)
Sells Low	0600–1900 M–F; other times by NOTAM	3,000 feet AGL to 10,000 feet MSL	Yes/Yes	Not authorized	
Ruby	0600–1900 M–F; other times by NOTAM	10,000 feet MSL to FL180	Yes/Yes	Not authorized	Ruby ATCAA (FL180-FL510)
Fuzzy	0700–1900 daily; other times by NOTAM	100 feet AGL to 10,000 feet MSL	Yes/Yes	Not authorized	

Note: [1]The ceilings of MOAs are officially charted as "to but not including FL180." For simplicity, this EIS uses the term "to FL180."
[2]The ceilings of the Outlaw and Jackal ATCAAs are defined in an LOA as FL510, but the DAF only receives the space above FL290 when the Outlaw and Jackal ATCAAs are scheduled with the Morenci and Reserve ATCAAs. The default ceiling is FL290.

Legend: AGL = above ground level; ATCAA = Air Traffic Control Assigned Airspace; DAF = Department of the Air Force; FL = Flight Level; LOA = Letter of Agreement; MOA = Military Operations Area; M–F = Monday through Friday; MSL = mean sea level; NOTAM = Notice to Air Missions.

1.2.2 Existing Operations

Average annual ***sorties*** generated from each of the DAF bases in Arizona are detailed in **Table 1.2-2**. The average annual sorties within the MOAs and ATCAAs addressed in this EIS are provided in **Table 1.2-3**; some of the MOAs are almost always used together and are therefore combined in this table and other tables throughout this EIS**.** A single sortie can occur across multiple MOAs depending on the training event being accomplished and how the airspace is scheduled; therefore, the columns showing sorties by base in **Table 1.2-3** should not be totaled since this would result in an inaccurate total number of sorties for the base. The primary users of the MOAs and the focus of this EIS include DAF fighter aircrews (A-10, F-16, and F-35) stationed at Arizona bases, but the MOAs also support other flying missions at these bases. As defined in FAA Order JO 7400.2P, *Procedures for Handling Airspace Matters*, Chapter 21, Paragraph 21-1-7 "to ensure optimum use of the airspace, the using agencies must, where mission requirements permit, make their assigned SUA available to the activities of other military units on a shared basis." Use of the existing DAF-managed MOAs by DAF units not stationed in Arizona or other military organizations is considered transient activity.

Table 1.2-2 Average Annual Sorties and Hours of Flight by Base and Aircraft Type[1]

	Total Annual Sorties	Total Hours of Flight
Davis-Monthan AFB		
A-10	9,700	18,900
Other[2]	3,200	11,100
Luke AFB		
F-16	6,500	8,100
F-35	11,000	15,400
Morris ANGB		
F-16	8,600	11,100
TOTAL	**39,000**	**64,600**

Notes: [1]A sortie is the flight of a single aircraft consisting of takeoff, mission, and landing. Annual sorties and hours in this table are based on Fiscal Year 2019 data which is representative of an average year of data available at the time of preparation of this document. Annual sorties can fluctuate year to year. This data was confirmed as still accurate by the Major Commands prior to publication of the Draft EIS.
[2]Other aircraft stationed at Davis-Monthan AFB include HH-60, HC-130, and EC-130.
Legend: AFB = Air Force Base; ANGB = Air National Guard Base.

Table 1.2-3 Average Annual Sorties by Airspace

MOA/ATCAA	Davis-Monthan AFB	Morris ANGB	Luke AFB		Other[1]	Total Local	Transient[2]	Grand Total
	A-10	F-16	F-16	F-35				
Tombstone	2400	850	0	0	100	3,350	100	3,450
Jackal/Outlaw	1,700	2,800	20	250	20	4,790	250	5,040
Morenci/Reserve	700	2,400	0	80	0	3,180	100	3,280
Gladden/Bagdad	20	0	3,700	3,500	0	7,220	200	7,420
Sells	250	2,400	3,400	6,400	40	12,490	1,100	13,590
Ruby/Fuzzy	1,900	2,700	20	450	20	5,090	150	5,240

Notes: [1]Other includes non-fighter aircraft stationed in Arizona (EC-130, HC-130, HH-60).
[2]Transients include DAF units stationed outside Arizona and other U.S. military. Type of aircraft varies but can include other fighter aircraft such as AV-8B, F-35, F-22, and F-18; helicopters such as MV-22 and H-60; and cargo aircraft such as C-130.
Legend: AFB = Air Force Base; ANGB = Air National Guard Base; ATCAA = Air Traffic Control Assigned Airspace; DAF = Department of the Air Force; MOA = Military Operations Area.

Sorties occur day and night in the existing MOAs as shown in **Table 1.2-4**. Also provided in **Table 1.2-4** is the percent of sorties that include supersonic speed. Supersonic speed does not occur for the duration of the sortie, but rather a small portion of time per sortie, that is, one or more short events of approximately 30 to 60 seconds.

Table 1.2-4 Day/Night and Supersonic Sorties

MOA/ATCAA	Total Sorties	Percent Day/Night[1]	Percent Including Supersonic[2]
Tombstone	3,450	89/11	0
Jackal/Outlaw	5,040	89/11	12
Morenci/Reserve	3,280	90/10	11
Gladden/Bagdad	7,420	88/12	51
Sells	13,590	85/15	47
Ruby/Fuzzy	5,240	90/10	0

Notes: [1]Night sorties are those flights that occur after sunset.
[2]Supersonic speed does not occur for the duration of the sortie.
Legend: ATCAA = Air Traffic Control Assigned Airspace; MOA = Military Operations Area.

1.3 BACKGROUND

The Department of Defense (DoD) enduring mission is to provide combat-credible military forces to deter war and protect the security of our Nation. The need for an appropriate training environment for today's fighters is required by the DoD National Defense Strategy. As the type and level of sophistication of threats to national security have evolved, so has the National Defense Strategy, resulting in changes to aircraft capabilities and weapons systems. These advanced capabilities have led to changes in the Tactics, Techniques, and Procedures developed for specific aircraft, which in turn necessitates a requirement to modernize the airspace available for aircrew training. As described in **Section 1.1**, *Introduction*, the airspace available to aircrews in this region was first charted decades ago and minimal improvements have been made over time in response to changes to the DAF aircraft inventory, capabilities, new training requirements, or expanded missions.

1.3.1 Training Requirements

Pilots must train as they would fight. Threat avoidance is one of the critical elements needed to achieve aircrew readiness and can only be attained by realistic, repetitive training. Aircrews need to have nearly automatic muscle reactions to survive and bring themselves and their aircraft home. A real-world mission differs significantly from the training allowed in a MOA that lacks requisite volume, altitude, and attributes, which introduces artificial constraints and limits. During a real-world mission, the fighter aircraft enters contested airspace at a medium altitude and identifies an opposing threat. Concurrently, the adversary's advanced radar systems, aircraft, surface-to-air missiles, and other threats track the aircraft. The aircrew uses its missiles to neutralize adversary aircraft and then prepares to release its air-to-ground ordnance to destroy the enemy target. The aircrew defeats the threat by employing ingrained training tactics including turning away, deploying chaff and flares, diving at supersonic speed to a low altitude to implement terrain masking in which the aircraft is hidden from view by putting higher terrain features between itself and the adversary aircraft. Once hidden from view, the aircrew can then continue the mission and return home safely.

In comparison, training within an insufficient MOA requires the training assets, that is, fighter aircraft and mock adversary aircraft, to be staged within the confines of the limited airspace. The aircrew simulates the launch of a missile and starts an escape at supersonic speed as they would in a real-world mission but then must reduce speed quickly to avoid going supersonic below the authorized altitude which is the opposite of what would occur in combat. The aircrew would normally attempt to implement terrain masking to avoid the threat, but this is not possible in a MOA with a high floor which makes it impossible to train to avoid being visible to the threat. The airspace limitations and constraints result in training maneuvers that are exactly the opposite of what would be required for combat survival. This counterproductive training experience, combined with the improving threat technology and increasing distances from which threats can acquire a fighter aircraft's location, threaten aircrew survivability and mission readiness.

While the DAF manages an extensive network of valuable SUA in the region, the volume, altitudes, and attributes of the MOAs which are used for non-hazardous training like the scenario described above are insufficient to meet the current training requirements, specifically those requiring low-altitude and supersonic operations. As shown in **Table 1.3-1**, much of the required training includes low-altitude flight and supersonic speed at lower altitudes for some portion of the training.

Table 1.3-1 Non-Hazardous Training Requirements

Brief Description	Includes Low-Altitude Flight	Includes Supersonic
Air Combat Training	No	Yes
Basic Fighter Maneuvers, Air Combat Maneuvering, Advanced Handling Characteristics	Yes	Yes
Air Interdiction	Yes	Yes
Combat Search and Rescue	Yes	No
Defensive Counter Air, Offensive Counter Air	Yes	Yes
Low-Altitude Step-Down Training	Yes	No
Strike Coordination and Reconnaissance	Yes	No
Suppression of Enemy Air Defenses	Yes	Yes
Tactical Intercepts	Yes	Yes
Transition	Yes	No

1.3.2 Regional Airspace Challenges

The existing DAF-managed MOAs have limited capacity to support the non-hazardous training requirements of aircrews stationed in Arizona. As currently configured, there is not enough airspace that provides the appropriate altitudes (down to 500 feet above ground level [AGL[3]] and lower), terrain variety, and attributes (ability to fly supersonic at lower altitude and use of chaff and flares) to support required training. This has resulted in saturation of the restricted airspace associated with BMGR that offers these attributes. In addition, increased non-DAF traffic in the region and environmental constraints have reduced the availability of the existing MOAs/ATCAAs.

Limited Airspace to Support Low-Altitude and Supersonic Training

As illustrated in **Table 1.3-1**, nearly all non-hazardous training for aircraft based in Arizona require low--altitude flight (500 feet AGL). More specifically, pilots of A-10s, HH-60s, and HC-130Js stationed at Davis-Monthan AFB have tactical missions that have a routine requirement to train *below* 500 feet AGL. Also, there are several Large Force Exercises and Personnel Rescue Recovery Exercises throughout the year that require low-altitude operations below 500 feet AGL. Currently, the aircrews rely on BMGR

[3] **Appendix B**, *Glossary*, provides information on altitude references used throughout this EIS: above ground level (AGL), mean sea level (MSL), and Flight Level (FL).

East to accomplish training requirements below 500 feet AGL that could occur within a MOA if they allowed the same low-level training.

In addition to added low-level flight capacity, the DAF needs to increase the diversity of low-altitude terrain beneath the MOAs to train pilots in simulated tactical weapons deliveries, low-altitude tactical navigation training, and proper terrain masking over the variety of terrain found in combat and rescue situations around the world. Lack of access to available and varied airspace for these activities has resulted in pilots not meeting Ready Aircrew Program requirements.

With regards to supersonic flight, fighter aircraft have a requirement to train for specific high-speed tactics (see **Table 1.3-1**). As described in **Section 1.3.1**, aircrews need to employ supersonic flight to simulate maneuvers required for real-world situations. Currently, only three DAF-managed MOAs in the region allow supersonic flight: Sells, Bagdad, and Gladden MOAs (see **Table 1.2-1**).

High-Demand Airspace is Saturated

BMGR East is the only live-fire range in Arizona fully available to the DAF. As such, it is in constant demand from all DAF aircrews in Arizona. Presently, the restricted areas associated with the range (R-2301E, R-2304, and R-2305, see **Figure 1.2-1**) provide training airspace from the surface up to FL800 (R-2301E) and FL240 (R-2304 and R-2305), and are authorized for several critical attributes: supersonic operations down to 5,000 feet MSL (R-2301E), use of chaff (surface to FL500), release of flares (minimum altitude 300 feet AGL with fire restrictions), laser operations, and live air-to-air and air-to-ground weapon deployment. This valuable airspace is also used to support non-hazardous training that could occur outside the range in MOAs. Scheduling restricted airspace for non-hazardous training prevents optimal use of the tactical ranges for essential live-fire training and other types of training that must occur in restricted airspace consequently adversely impacting other essential readiness training.

BMGR East range assets and restricted airspace support training for military units throughout the southwestern U.S. Because of the high demand of this finite resource, the 56 RMO must reduce the amount of time each unit can schedule the range and the units currently receive only 78 percent of their requested time. This means certain aspects of training syllabi are either curtailed, delayed, or restructured to occur over several training events requiring more time and at a greater cost but with reduced quality of training. As Luke AFB reaches full capacity for their F-35 fleet, it is anticipated that access to BMGR East by all the units will decrease to 67 percent of requested time. Such a reduction in access to the range will have a significant impact to DAF readiness.

Increased Civil and Other Traffic

At the same time the DAF mission has evolved and grown (and is still growing), the availability of the existing MOAs and ATCAAs has been reduced through several ***Letters of Agreement (LOAs)*** and airspace recalls by the FAA due to increases in non-military air traffic. As a consequence, even less of the volume of the already insufficient charted MOAs is actually available to the military for training. For example, departures from Phoenix Sky Harbor International Airport restrict use of the northern segment of Outlaw, Jackal, and Reserve MOAs (see **Figure 1.2-1**). Although the existing LOA permits FAA to routinely schedule and use this segment, over time, the increased use by commercial aircraft has resulted in a near-permanent elimination of this area for military training. Along the southern boundary of Outlaw and Jackal MOAs/ATCAAs, military training is restricted to the MOA only (below FL180) since the ATCAA in this area is routinely recalled for use by civil traffic. These reductions in the charted airspace have impacted the type of training that can occur in this airspace, effectively eliminating the possibility to perform 4 v 4 events (i.e., training events that have eight aircraft at a time), which accounts for approximately 20 percent of the training performed by squadrons at Morris ANGB.

Another example of the impacts to SUA use from increased non-military traffic is a 5-nautical mile corridor along the Mexico-U.S. border affecting all the SUA in this area (see **Figure 1.2-1**) that is reserved for Department of Homeland Security, U.S. Customs and Border Protection remote piloted aircraft, thereby reducing the usable vertical and lateral area of the Tombstone MOA/ATCAA below FL210.

Environmental Constraints

Aircrew training throughout Arizona is adversely impacted by environmental constraints. For example, there are defined avoidance areas associated with Mexican spotted owl and Bald and Golden Eagle nests beneath most of the airspace. These avoidances create "bubbles" in the airspace hindering the use. Other projects, such as wind farms and transmission line corridors, also contribute to restrictions of training airspace. These environmental constraints mean less of the charted airspace is actually available for military use.

1.4 PURPOSE AND NEED FOR PROPOSED ACTION

The DAF is proposing to address the current insufficient capacity of the MOAs to support non-hazardous training requirements of aircrews stationed in Arizona as described in **Section 1.3.2**, *Regional Airspace Challenges.* The **purpose** of the Proposed Action is to optimize existing DAF-managed MOAs to address the existing and future training deficiencies of aircrews stationed at Davis-Monthan AFB, Luke AFB, and Morris ANGB due to insufficient airspace.

The **need** for the Proposed Action is driven by two primary factors: the need for aircrews to be able to conduct flight training near their home base; and the need to conduct required training to ensure readiness and increase survivability. As currently configured, there is not enough airspace that provides the appropriate altitudes (down to 500 feet AGL and lower), terrain variety, and attributes (ability to fly supersonic at lower altitude and use of chaff and flares) to support required training.

The DAF determined the Proposed Action and any alternatives must meet the following selection standards:

- Optimize DAF-managed MOAs accessible to bases in Arizona. DAF aircrews cannot rely on the availability of another service's airspace to accomplish daily requirements.
- Optimize airspace within a reasonable distance from the bases. Flying long distances to remote or out-of-state training airspace and returning to the home bases in Arizona would substantially limit valuable training time and increase fuel consumption and cost. The aircraft need to fly to the training airspace, conduct the specified training, and return to base with adequate fuel reserves for safety. Even with the option of aerial refueling, traveling long distances for daily training is not reasonable. Reasonable alternatives must provide suitable training airspace within 150 nautical miles of the bases.
- Improve the existing MOAs to support low-altitude training and supersonic at lower altitudes to address the existing training deficiencies.

- Increase the variety of terrain in existing MOAs overflown during low-altitude training to improve training realism.
- Adjust the published times of use to align with how the MOAs are currently used.
- Reduce use of BMGR East restricted areas for non-hazardous training to improve availability of the high-demand airspace and live-fire ranges for hazardous training.

1.5 Regulatory and Government-to-Government Consultation

Prior to making a decision, the responsible Federal agency must consult with and obtain the comments of any other Federal agency which has jurisdiction by law or special expertise with respect to any environmental impact involved. For this EIS, the DAF is consulting with the following regulatory agencies: U.S. Fish and Wildlife Service (USFWS), Arizona State Historic Preservation Office (SHPO), New Mexico SHPO, and the National Park Service (NPS). The DAF has also initiated government-to-government consultation with Native American Tribes with reservation lands or historical ties to the land associated with this EIS.

1.5.1 Regulatory Agency Consultations

Under the Endangered Species Act (ESA), it is the responsibility of the action agency (in this case the DAF) to determine whether a proposed action “may affect” species listed as endangered, threatened, or proposed for listing, or their designated critical habitats. If the action proponent determines it may affect a listed species, they must consult with the USFWS. During the scoping phase of the project, the DAF provided a letter to USFWS Southwest Regional Office, USFWS Arizona Ecological Services Field Office, and USFWS New Mexico Ecological Services Field Office announcing the intent to prepare this EIS and inviting their comments and participation in the project. A request for informal consultation on the determinations in this EIS was provided to all of the above noted offices with a copy of the Draft EIS. A Biological Assessment for all species for which a “may effect” determination is made will be prepared and submitted to USFWS once a Preferred Alternative has been identified by the DAF, if necessary. See **Section 3.6**, *Natural Resources* for additional information on special-status species and results of ESA consultation.

The Arizona Game and Fish Department (AZGFD) has jurisdictional authority and public trust responsibilities to protect and conserve the state fish and wildlife resources in Arizona. They are a cooperating agency on this EIS, see **Section 1.6**. They have been given the opportunity to review the EIS prior to public release of the Draft EIS. The DAF currently coordinates with AZGFD to determine necessary seasonal avoidances of Bald and Golden Eagle nests throughout Arizona.

Several federal laws and regulations have been established to manage cultural resources, including the National Historic Preservation Act (NHPA) (54 USC 300101 et seq.), the Archaeological and Historic Preservation Act (6 USC 469-469c), the American Indian Religious Freedom Act (42 USC 1996), the Archaeological Resources Protection Act (6 USC 470aa–470mm), and the Native American Graves Protection and Repatriation Act (25 USC 3001-3013). Section 106 of the NHPA requires all Federal agencies to consider the effects of their undertakings on historic properties and seek to avoid, minimize, or mitigate adverse effects to these properties (36 CFR 800.1(a)). The DAF is consulting with the Arizona SHPO, New Mexico SHPO, and NPS. During the scoping phase of this EIS, these agencies received a letter announcing the intent to prepare this EIS and inviting their comments and participation in the project. A copy of this Draft EIS and an assessment of the effects to historical properties was provided to the above noted offices. See **Section 3.10**, *Cultural Resources* for additional information and results of these consultations.

1.5.2 Government-to-Government Consultation

Executive Order (EO) 13175, *Consultation and Coordination with Indian Tribal Governments,* charges all executive departments and federal agencies with engaging in regular, meaningful, and robust consultation with Tribal Nation officials in the development of Federal policies that have Tribal implications. Additionally, DoD Instruction 4710.02, *DoD Interactions With Federally Recognized Tribes* and Department of the Air Force Instruction (DAFI) 90-2002, *Interactions with Federally Recognized Tribes,* emphasize the importance of respecting and consulting with tribal governments on a government-to-government basis in recognition of their sovereignty as a nation. Prior to the scoping phase of this EIS, the DAF initiated government-to-government consultation with 30 Tribes and Pueblos that are located beneath or near the affected airspace or may have traditional ties to these lands. These consultations are occurring according to the preferences of the Tribe and have included various letters, emails, phone conversations, and in person meetings between DAF and Tribal leadership. See **Section 3.10**, *Cultural Resources* for additional information and results of these consultations.

1.6 PUBLIC AND AGENCY INVOLVEMENT

The Air Force Environmental Impact Analysis Process (32 CFR Part 989), FAA Order 1050.1F, and CEQ regulations (40 CFR 1503.1) specify public and agency stakeholder involvement at various junctures in the development of an EIS, including: (1) scoping prior to the preparation of a Draft EIS, and (2) public review of the Draft EIS prior to finalizing the document. The FAA has participated in the public involvement activities for this EIS to satisfy their public involvement requirement per FAA Order 1050.1F, *Environmental Impacts: Policies and Procedures*. Public and agency stakeholder involvement for this EIS is summarized in **Appendix D**. All aeronautical-related comments will be submitted to FAA for consideration during their aeronautical analysis of this proposal.

The DAF is soliciting comments from interested tribal members, local, state, and federal elected officials, as well as interested members of the public in compliance with the NHPA and its implementing regulations (36 CFR 800.2). The regulations that govern NHPA implementation allow for a parallel NEPA and Section 106 process in an effort to streamline the environmental compliance process. The EIS includes identification and evaluation of impacts to historic properties. Public and stakeholder comments concerning historic properties will be accepted concurrent with the Draft EIS comments.

The FAA processes requests for the establishment of SUA in accordance with FAA Order JO 7400.2P, *Procedures for Handling Airspace Matters*. As part of the process, the FAA will publicly circularize the proposed airspace to solicit information to assist in determining what effect it would have to navigable airspace. That circularization will occur in addition to public involvement associated with the EIS. Any comments related to environmental issues will be addressed as necessary in the Final EIS.

1.7 COOPERATING AGENCIES

The DAF is the lead agency for this EIS. Several agencies are cooperating agencies as defined in 40 CFR 1508.1(e).

1.7.1 Federal Aviation Administration

Having jurisdiction by law over the National Airspace System (NAS), the FAA performs its role as a cooperating agency for the establishment and designation of SUA in accordance with the NEPA implementing regulations at 40 CFR Section 1501.8(a) on cooperating agencies; FAA's NEPA implementing Order 1050.1F, paragraph 8-2, *Adoption of Other Agencies' NEPA Documents*; and FAA Order JO 7400.2P, Chapters 21 and 32, *Appendix 8 – FAA Special Use Airspace Environmental Processing Procedures*, which outlines the process by which the FAA works with the DoD on projects involving DoD use of SUA and the guidelines set forth in the Memorandum of Understanding between FAA and DoD concerning environmental review of SUA actions (Appendix 7, FAA Order JO 7400.2P).

The FAA may or may not adopt this EIS to comply with their NEPA procedures defined in FAA Order 1050.1F, prior to making a decision to chart the proposed MOA modifications addressed in this EIS. They will also issue their own Record of Decision (ROD) for this action.

1.7.2 National Park Service

The NPS units within the project area include Chiricahua National Monument, Organ Pipe Cactus National Monument, and Saguaro National Park. As a cooperating agency, the NPS was given the opportunity to review the EIS prior to public release of the Draft EIS and provide feedback on potential impacts to their land management areas.

In addition, NPS acts on behalf of the Secretary of the Interior in undertakings that may impact National Historic Landmarks per NHPA and its implementing regulations at 36 CFR Part 800, of which there are eight (Ventana Cave, Point of Pines, Sierra Bonita, Kinishba, Double Adobe, San Bernardino, Phelps Dodge General Office Building, and Fort Apache/Theodore Roosevelt School) in the project area. The DAF is consulting with NPS on potential effects to these properties.

1.7.3 U.S. Forest Service

U.S. Forest Service (USFS), Southwestern Region lands within the project area include Apache-Sitgreaves National Forest, Coronado National Forest, Gila National Forest, and Tonto National Forest. As a cooperating agency, the USFS Southwestern Region was given the opportunity to review the EIS prior to public release of the Draft EIS and provide feedback on potential impacts to their land management areas.

1.7.4 Arizona Game and Fish Department

The AZGFD has jurisdictional authority and public trust responsibilities to protect and conserve the state fish and wildlife resources. As a cooperating agency, the AZGFD was given the opportunity to review the EIS prior to public release of the Draft EIS and provide feedback on potential impacts to state fish and wildlife resources.

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2.0 PROPOSED ACTION AND ALTERNATIVES

2.1 PROPOSED ACTION

The DAF is proposing to alleviate training shortfalls and address evolving training needs for aircrews stationed in Arizona by conducting training in modified airspace. This would necessitate modifications to the volume and attributes of 10 existing DAF-managed MOAs/ATCAAs that the FAA would be responsible for formally implementing as requested by the DAF.

The Proposed Action includes changing the published times of use; adjusting the horizontal dimensions of some airspace; lowering the floor of some airspace to allow for low-altitude training; and adjusting the attributes to allow for supersonic speed at lower altitude, use of chaff, and lowering the release altitude for flares.

The Proposed Action does **not include** changes to:

- Infrastructure or personnel at any of the bases
- Airfield or runway operations (frequency or types of aircraft) at any of the bases
- Aircraft inventory or squadron assignments at any of the bases
- Changes to land use beneath any of the airspace
- Areas of transit between the bases and the training airspace
- Location, frequency, or volume of munitions used at ranges

2.1.1 Times of Use

The Proposed Action includes an administrative change to the published times of use in the aeronautical charts for 10 existing DAF-managed MOAs. The MOAs are routinely used outside of the current published times of use through notice to air missions (NOTAMs). The proposed changes to the published times would better align with how the MOAs are currently used and eliminate the administrative burden of issuing NOTAMs on a recurring basis. Also, the proposed changes would make the published times of use for contiguous MOAs and those that are almost always scheduled together consistent, which would improve scheduling. Adjusting the published times of use would not change the percentage of operations that occur during the nighttime from those presented in **Section 1.2.2, Table 1.2-4**. Nighttime operations outside of the published times currently occurs through the NOTAM process.

It should be noted that published times of use does not imply military aircraft are present the entire time. Military use of MOAs is scheduled in advance for discreet blocks of time on any given day to accomplish the planned training event(s). On the day of training, the MOA is “activated” a little before the scheduled event and “deactivated” when the FAA receives notification from the military that the event is complete. If there are multiple discrete events scheduled throughout the day, the FAA may or may not release the airspace back to civil users between these discreet training blocks depending on the amount of time between events. Most training events typically last 40 minutes to an hour. **Table 2.1-1** details the current and proposed published times of use.

Table 2.1-1 Current and Proposed Published Times of Use

MOA	Current Published Times of Use (No Action)	Proposed Published Times of Use
Tombstone	0600–2100 M–F, other times by NOTAM[1]	0600–2100 **daily**, other times by NOTAM
Outlaw	0700–1800 M–F 1800–2200 M–F by NOTAM Intermittent weekends by NOTAM	**0600–2200 M–F,** other times by NOTAM
Jackal	0700–1800 M–F 1800–2200 M–F by NOTAM Intermittent weekends by NOTAM	**0600–2200 M–F,** other times by NOTAM
Morenci	0600–2100 M–F, other times by NOTAM	0600–**2200** M–F, other times by NOTAM
Reserve	By NOTAM	**0600–2200 M–F,** other times by NOTAM
Bagdad	0600–1900 M–F, other times by NOTAM	0600–**0000** M–F, other times by NOTAM
Gladden	0600–1900 M–F, other times by NOTAM	0600–**0000** M–F, other times by NOTAM
Sells	0600–1900 M–F, other times by NOTAM	0600–**0000** M–F, other times by NOTAM
Ruby	0600–1900 M–F, other times by NOTAM	0600–**0000** M–F, other times by NOTAM
Fuzzy	0700–1900 daily, other times by NOTAM	**0600–0000 M–F**, other times by NOTAM

Note: [1]Military use of the MOA outside of the published times of use requires advanced notification to other airspace users. This is done by publishing a NOTAM.

Legend: M–F = Monday through Friday; MOA = Military Operations Area; NOTAM = Notice to Air Missions.

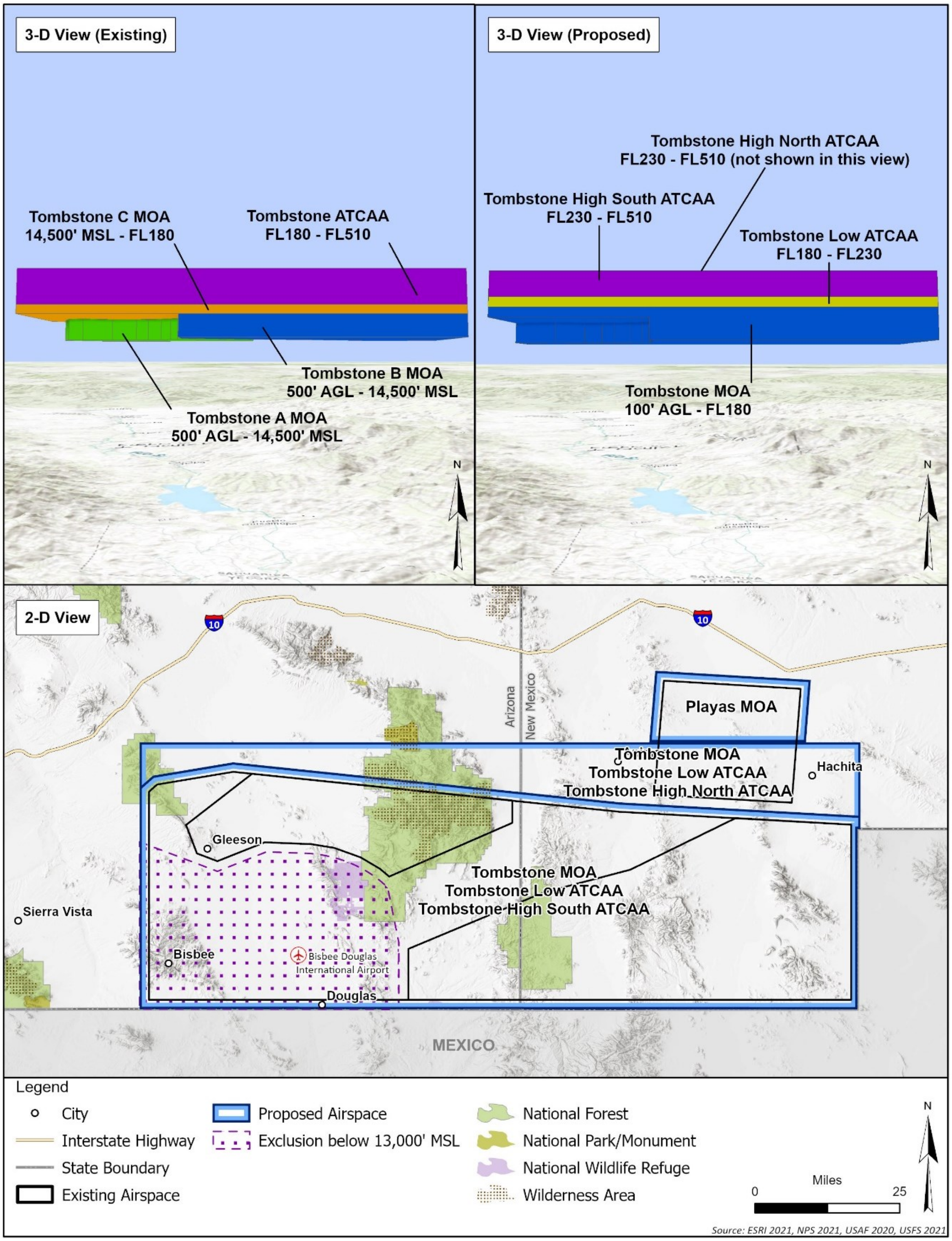
2.1.2 Horizontal and Vertical Dimensions

Under the Proposed Action, the horizontal dimension of Tombstone MOA/ATCAA and the vertical dimensions of Tombstone, Outlaw, Jackal, Bagdad, and Gladden MOAs/ATCAAs would be modified. These modifications would increase the volume of airspace that can support low-altitude flights and add terrain variety for these training events. There would be no changes to the horizontal or vertical dimensions of the Morenci, Reserve, Sells, Ruby, or Fuzzy MOAs/ATCAAs since these MOAs have sufficient dimensions to support the current and foreseeable future missions that occur there.

2.1.2.1 Tombstone MOA/ATCAA

The northern boundary of the Tombstone MOA would be expanded approximately 10 nautical miles to the north. The expansion would provide training airspace of approximately 40 by 90 nautical miles compared to the current 30 by 90 nautical miles. The existing A, B, and C components would be combined into one MOA, the floor would be lowered to 100 feet AGL (currently 500 feet AGL), and the ceiling would remain up to but not including FL180 (**Figure 2.1-1**). An exclusion below 13,000 feet MSL surrounding Bisbee Douglas International Airport, similar to the current exclusion area, would be established. There is an Air Traffic Service (ATS) route, V66, that currently runs northeast from Bisbee Douglas International Airport through the open space between the existing Tombstone A and B.

The existing ATCAA would be expanded to the north to align with the proposed MOA boundary; however, the ATCAA would be divided vertically into a Low and High ATCAA. The proposed Low ATCAA would exist from FL180 to FL230. The proposed High ATCAA would exist from FL230 to FL510, but would be further divided into North and South segments. The High North ATCAA would align with only the proposed expansion area. The High South ATCAA would align with the current MOA boundary. These components are illustrated on **Figure 2.1-1**. The High North ATCAA could be recalled by the FAA when needed for inbound and outbound civil Instrument Flight Rules (IFR) traffic to Tucson International Airport and Phoenix Sky Harbor International Airport and still allow for military training below FL230 without hindering the civil traffic. Expanding the northern boundary of the Tombstone MOA and ATCAA would absorb the southern half of the existing Playas MOA (which exists from



Note: 3D Views are not to scale and are provided for illustrative purposes only.
Legend: ATCAA = Air Traffic Control Assigned Airspace; FL = Flight Level; MSL = mean sea level; MOA = Military Operations Area.

Figure 2.1-1 Proposed Tombstone MOA/ATCAA

300 feet AGL up to but not including FL180, with an ATCAA above that extends to FL230). The Playas MOA/ATCAA would be reduced by shifting the southern boundary north to avoid overlapping with the new Tombstone MOA/ATCAA.

2.1.2.2 Outlaw and Jackal MOAs/ATCAAs

The horizontal dimensions of the Outlaw and Jackal MOAs/ATCAAs would remain unchanged. The floor of Outlaw and Jackal MOAs would be lowered to 500 feet AGL (currently 8,000 feet MSL or 3,000 feet AGL; and 11,000 feet MSL or 3,000 feet AGL, respectively) to increase the area of MOAs capable of supporting low-altitude training within the region (**Figure 2.1-2**). The ceiling of the Jackal Low MOA, which lies beneath the Jackal MOA, would be reduced to 500 feet AGL. Also included in the Proposed Action would be an administrative amendment of the LOA to allow the default scheduling of the Outlaw and Jackal ATCAAs to FL510 (currently the default is FL290) without having to also schedule the adjacent Morenci and Reserve ATCAAs.

2.1.2.3 Gladden and Bagdad MOAs/ATCAAs

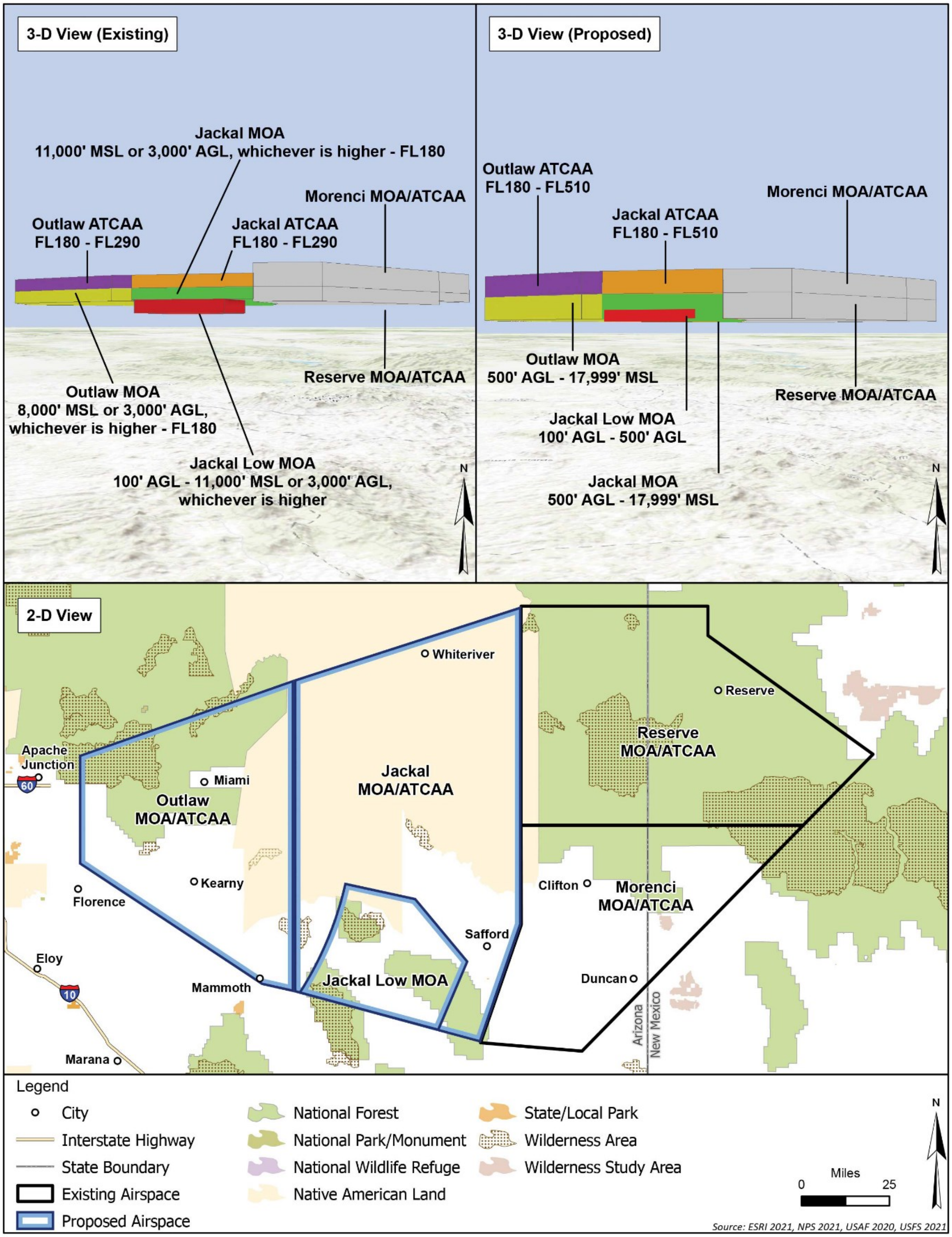
The horizontal dimensions of the Gladden and Bagdad MOAs and associated ATCAAs would remain unchanged. The floor of the MOAs would be lowered to 500 feet AGL (the current floor is designated as 7,000 feet MSL or 5,000 feet AGL, whichever is higher) to increase the area of MOAs capable of supporting low-altitude training within the region (**Figure 2.1-3**). The ceilings of the MOAs and the vertical dimensions of the ATCAAs would remain unchanged.

In summary, the floor of several MOAs would be lowered to provide additional airspace for low-altitude training for the current missions of the primary aircraft using each MOA. The proposed floor compared to the existing floor of the MOAs is presented in **Table 2.1-2**. In addition, required training terrain variety in the region would be improved by establishing new low-altitude training airspace that covers a variety of vertical terrain features. The only vertical change to the ATCAAs would be the default scheduling for Outlaw and Jackal ATCAAs to FL510.

Table 2.1-2 Summary of Proposed Altitude Changes

MOA	Existing Floor (No Action)	Proposed Floor
Tombstone	500 feet AGL	100 feet AGL
Outlaw	8,000 feet MSL or 3,000 feet AGL, whichever is higher	500 feet AGL
Jackal	11,000 feet MSL or 3,000 feet AGL, whichever is higher	500 feet AGL
Jackal Low	100 feet AGL	No change
Morenci	1,500 feet AGL	No change
Reserve	5,000 feet AGL	No change
Bagdad	7,000 feet MSL or 5,000 feet AGL, whichever is higher	500 feet AGL
Gladden	7,000 feet MSL or 5,000 feet AGL, whichever is higher	500 feet AGL
Sells	10,000 feet MSL	No change
Sells Low	3,000 feet AGL	No change
Ruby	10,000 feet MSL	No change
Fuzzy	100 feet AGL	No change

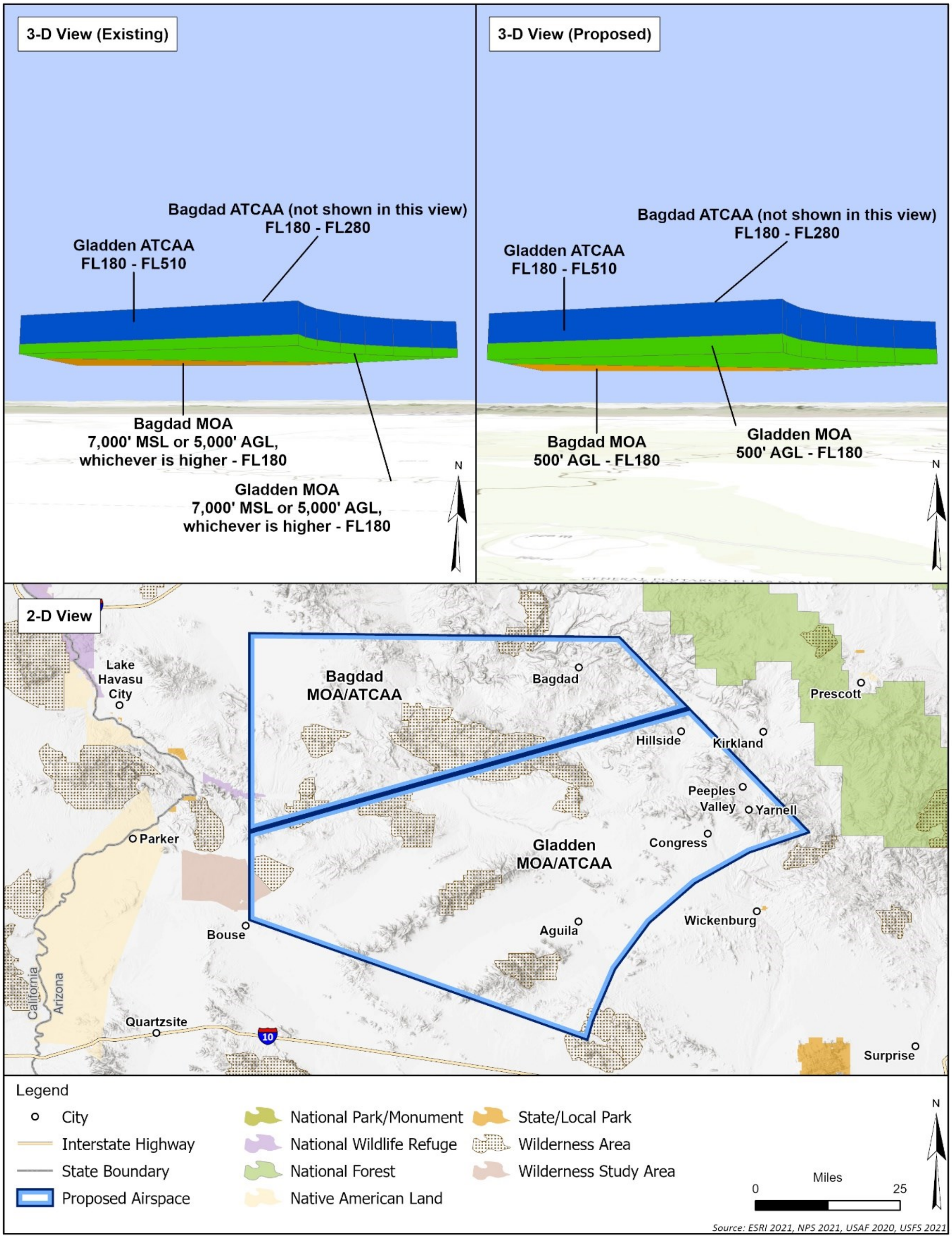
Legend: AGL = above ground level; MSL = mean sea level; MOA = Military Operations Area.



Note: 3D Views are not to scale and are provided for illustrative purposes only.

Legend: ATCAA = Air Traffic Control Assigned Airspace; FL = Flight Level; MSL = mean sea level; MOA = Military Operations Area.

Figure 2.1-2 Proposed Outlaw, Jackal MOAs/ATCAAs



Note: 3D Views are not to scale and are provided for illustrative purposes only.
Legend: AGL = above ground level; ATCAA = Air Traffic Control Assigned Airspace; FL = Flight Level; MSL = mean sea level; MOA = Military Operations Area.

Figure 2.1-3 Proposed Gladden and Bagdad MOAs/ATCAAs

2.1.3 Attributes

Flares are currently used in all of the MOAs. Chaff is currently used in all of the MOAs except for the Tombstone MOA. To accomplish training requirements, changes to the MOA attributes are also proposed. Units stationed at Davis-Monthan AFB have a requirement to employ chaff to accomplish training requirements, thus the Proposed Action includes using chaff within the Tombstone MOA. The Proposed Action also includes setting the minimum altitude for flare release in Tombstone, Outlaw, Jackal, Gladden, and Bagdad MOAs to 2,000 feet AGL to align with the proposed lower floor. Flares are designed to burn out completely within 3 to 5 seconds, during which time the flare would fall between 200 to 400 feet. Minimum flare release altitudes are established to ensure public health and safety and 2,000 feet AGL is the DAF standard minimum release altitude over land not owned or controlled by the DAF. It is the responsibility of the Wing Commander to develop policy to ensure public and pilot safety during operations within the MOA. Implementing restrictions on the use of flares based on local fire conditions is a best management practice that is currently implemented for each MOA and is defined in individual unit policies. These restrictions vary depending on the local conditions beneath the MOA and would continue as part of the Proposed Action.

Supersonic flight is currently authorized in Gladden, Bagdad, and Sells MOAs at 10,000 feet MSL and above and would remain unchanged with the Proposed Action. The Proposed Action includes authorizing supersonic flight down to 5,000 feet AGL in Tombstone, Outlaw, Jackal, Morenci, and Reserve MOAs. The existing and proposed supersonic flight authorizations are provided in **Table 2.1-3**. These changes would increase the capacity of the regional airspace to support non-hazardous training that requires supersonic flight at lower altitudes.

Table 2.1-3 Existing and Proposed Supersonic Flight Authorization

MOA/ATCAA	Existing Minimum Altitude (No Action)	Proposed Minimum Altitude
Tombstone	FL300	5,000 feet AGL
Outlaw	FL300	5,000 feet AGL
Jackal	FL300	5,000 feet AGL
Morenci	FL300	5,000 feet AGL
Reserve	FL300	5,000 feet AGL
Bagdad	10,000 feet MSL	No change
Gladden	10,000 feet MSL	No change
Sells	10,000 feet MSL	No change
Ruby	Not authorized	No change
Fuzzy	Not authorized	No change

Legend: AGL = above ground level; ATCAA = Air Traffic Control Assigned Airspace; FL = Flight Level; MOA = Military Operations Area; MSL = mean sea level.

2.2 ALTERNATIVES CARRIED FORWARD FOR ANALYSIS

The EIS evaluates a No Action Alternative per 40 CFR 1502.14(c) (numbered as Alternative 1 in this EIS). Three action alternatives to optimize the existing MOAs are also evaluated. Alternative 2 includes all proposed modifications to optimize the MOAs. Alternatives 3 and 4 are variations of Alternative 2. A Summary of Alternatives Reference tables is provided in Appendix E for the reader's convenience. The Proposed Action (numbered as Alternative 2 in this EIS) is the optimal operational alternative since this best addresses the training needs for aircrews stationed at Davis-Monthan AFB, Luke AFB, and Morris ANGB. However, the DAF will consider all public and stakeholder input as part of the process of identifying the Preferred Alternative.

2.2.1 Alternative 1 – No Action

The No Action Alternative is carried forward for analysis consistent with CEQ regulations (40 CFR 1502.14(c)) to provide a baseline against which to measure the impacts of the Proposed Action and alternatives. Under the No Action Alternative, inefficient training would continue in the existing MOAs as currently charted and training requirements would remain unmet. This alternative is not reasonable as readiness would be adversely impacted. The quality of the training would continue to degrade from executing training operations in insufficient MOAs. See **Section 1.3**, *Background*, for descriptions of training requirements and existing airspace challenges.

The annual sorties under the No Action Alternative for this analysis are detailed in **Table 2.2-1**. These sorties are based on the current operations (see **Section 1.2.2, Table 1.2-3**), but have been adjusted to account for a reduction in F-16 sorties and an increase in F-35 sorties to align with the final basing of the F-35 at Luke AFB. The F-35 basing was addressed in a previous NEPA decision document (DAF 2012), but the basing was not fully complete at the time of preparation of this EIS; therefore, the additional F-35 sorties are not accounted for in the current operations data presented in **Table 1.2-3**. The basing action is unrelated to the Proposed Action in this EIS and would occur regardless of the decision made on this action; therefore, those additional operations associated with the F-35 basing action are included in the analysis of the No Action Alternative. The proportion of the total sorties that would occur at night, after sunset, as well as the proportion of sorties that would include supersonic flight are detailed in **Table 2.2-2**.

Table 2.2-1 Annual Sorties – Alternative 1 – No Action

MOA/ATCAA	Davis-Monthan AFB	Morris ANGB	Luke AFB		Other[1]	Total Local	Transient[2]	Grand Total
	A-10	F-16	F-16	F-35				
Tombstone	2,400	850	0	0	100	3,350	100	3,450
Outlaw/Jackal	1,700	2,800	20	400	20	4,940	250	5,190
Morenci/Reserve	700	2,400	0	150	0	3,250	100	3,350
Gladden/Bagdad	20	0	1,300	5,400	0	6,720	200	6,920
Sells	250	2,400	1,200	9,800	40	13,690	1,100	14,790
Ruby/Fuzzy	1,900	2,700	20	700	20	5,340	150	5,490

Notes: [1]Other includes non-fighter aircraft stationed in Arizona (EC-130Hs, HC-130Js, HH-60Gs).
[2]Transients include DAF units stationed outside Arizona and other U.S. military. Type of aircraft varies but can include other fighter aircraft such as AV-8B, F-35, F-22, and F-18; helicopters such as MV-22 and H-60; and cargo aircraft such as C-130.

Legend: AFB = Air Force Base; ATCAA = Air Traffic Control Assigned Airspace; DAF = Department of the Air Force; MOA = Military Operations Area.

Table 2.2-2 Day/Night and Supersonic Sorties – Alternative 1 – No Action

MOA/ATCAA	Total Sorties	Percent Day/ Night[1]	Percent Including Supersonic[2]
Tombstone	3,450	89/11	0
Jackal/Outlaw	5,190	89/11	12
Morenci/Reserve	3,350	90/10	11
Gladden/Bagdad	6,920	88/12	65
Sells	14,790	85/15	60
Ruby/Fuzzy	5,490	90/10	0

Notes: [1] Night sorties are those flights that occur after sunset.
[2] The percent supersonic under No Action is different from the percent provided in Existing Operations, **Table 1.2-4** for Gladden/Bagdad and Sells. The operations for No Action have been adjusted to account for an increase in F-35 operations and a decrease in F-16 operations from Luke AFB. The F-35 has a higher supersonic requirement than the F-16 that it is replacing.
Legend: ATCAA = Air Traffic Control Assigned Airspace; MOA = Military Operations Area.

2.2.2 Alternative 2 – Proposed Action

The Proposed Action (Alternative 2) would alleviate training shortfalls and address evolving training needs of DAF aircrews by conducting training in 10 fully optimized MOAs/ATCAAs. The changes to the times of use, horizontal and vertical dimensions, and attributes described in **Section 2.1** would be implemented. Optimizing the MOAs would meet the purpose and need and selection standards (see **Section 1.4**, *Purpose and Need for Proposed Action*) and result in significant improvements to DAF's capability to meet training requirements and address challenges with training in the existing regional airspace (see **Section 1.3.2**, *Regional Airspace Challenges*). In summary, the proposed modifications described in **Section 2.1** include:

- Modify published times of use for all MOAs as defined in **Table 2.1-1** to align with how the MOAs are currently used.
- Combine Tombstone A, B, and C and expand northern boundary of Tombstone MOA and associated Tombstone ATCAA (see **Figure 2.1-1**). Establish an exclusion below 13,000 feet MSL surrounding Bisbee Douglas International Airport. Reduce boundary of Playas MOA.
- Lower the floor of Tombstone MOA to 100 feet AGL and the floors of Outlaw, Jackal, Gladden and Bagdad MOAs to 500 feet AGL (see **Section 2.1.2, Table 2.1-2**).
- Amend the LOA for scheduling the Outlaw and Jackal ATCAAs to default to FL510.
- Authorize the use of chaff in the Tombstone MOA.
- Adjust the minimum flare release altitude to 2,000 feet AGL in Tombstone, Outlaw, Jackal, Gladden, and Bagdad MOAs.
- Authorize supersonic flight down to 5,000 feet AGL in Tombstone, Outlaw, Jackal, Morenci, and Reserve MOAs (see **Section 2.1.3, Table 2.1-3**).

Optimizing the MOAs in the region would allow for non-hazardous training (notably, low-altitude training and supersonic operations at lower altitudes) to occur in DAF-managed MOAs, improving the availability of BMGR East restricted areas to support hazardous training as is its purpose. The optimized MOAs would provide training and scheduling flexibility for all the DAF units that need to use the airspace. The Proposed Action would not increase the total number of operations originating from any of the bases, but rather these operations would be shifted from the BMGR East restricted areas to the MOAs.

The projected sorties to occur within the fully optimized airspace are detailed in **Table 2.2-3**. The sorties for each MOA include sorties that currently occur there and those that could occur there with optimization, to include the additional F-35s anticipated at Luke AFB. The use of the individual MOAs could fluctuate year to year. In this analysis the number of sorties projected to occur in each MOA is increased by 10 percent to conservatively account for these minor fluctuations in training activity that would allow for flexibility in use of the MOAs as a collective regional asset. Thus, the total sorties for all MOAs combined is not an accurate representation of the total sorties in the region, as an increase in use of one MOA would result in a corresponding decrease in other MOA(s).

The proportion of the total sorties that would occur at night, after sunset, as well as the proportion of sorties that would include supersonic flight are detailed in **Table 2.2-4**. The percent of sorties that occur during the daytime and nighttime would not change under the Proposed Action even though the published times of use would be extended further into the night. This is because night operations are already occurring during the proposed published times of use through NOTAMs. Changing the published times of use would align with how the airspace is currently used. Supersonic speed does not occur for the duration of the sortie, but rather a small fraction of time (one or more short events of approximately 30–60 seconds).

Chaff and flare usage directly corresponds to the sorties within a given MOA. The proposed chaff and flare usage associated with the proposed sorties under Alternative 2 is provided in **Table 2.2-5**. Flares are currently used in all MOAs. Chaff is currently used in all MOAs except for Tombstone MOA. As stated above, the use of the individual MOAs could fluctuate year to year and the proposed sorties have been increased to account for minor fluctuations and allow for flexibility in use of the MOAs as a collective regional asset. Thus, the proposed chaff and flares for all MOAs should not be totaled as this would be an inaccurate representation of the total amount expended within the region. **Appendix F** provides detailed descriptions of the types of chaff and flares used.

Table 2.2-3 Proposed Annual Sorties – Alternative 2

MOA/ATCAA	No Action	Proposed								Change from No Action
		Davis-Monthan AFB	Morris ANGB	Luke AFB		Other[1]	Total Local	Transient[2]	Grand Total	
		A-10	F-16	F-16	F-35					
Tombstone	3,450	6,600	1,100	0	0	150	7,850	150	8,000	+4,550
Outlaw/Jackal	5,190	2,100	3,400	20	750	40	6,310	300	6,610	+1,420
Morenci/Reserve	3,350	850	2,900	0	150	0	3,900	150	4,050	+700
Gladden/Bagdad	6,920	20	0	1,600	7,300	0	8,920	200	9,120	+2,200
Sells	14,790	350	3,100	1,400	11,600	60	16,510	1,300	17,810	+3,020
Ruby/Fuzzy	5,490	2,300	4,200	20	850	40	7,410	200	7,610	+2,120

Notes: [1]Other includes non-fighter aircraft stationed in Arizona (EC-130Hs, HC-130Js, HH-60Gs).
[2]Transients include DAF units stationed outside Arizona and other U.S. military. Type of aircraft varies but can include other fighter aircraft such as AV-8B, F-35, F-22, and F-18; helicopters such as MV-22 and H-60; and cargo aircraft such as C-130.

Legend: AFB = Air Force Base; ANGB = Air National Guard Base; ATCAA = Air Traffic Control Assigned Airspace; DAF = Department of the Air Force; MOA = Military Operations Area.

Table 2.2-4 Proposed Nighttime and Supersonic Sorties – Alternative 2

MOA/ATCAA	Percent Day/Night[1]		Percent Including Supersonic[2]	
	No Action	Proposed	No Action	Proposed
Tombstone	89/11	No change	0	1
Outlaw/Jackal	89/11	No change	12	14
Morenci/Reserve	90/10	No change	11	No change
Gladden/Bagdad	88/12	No change	65	66
Sells	85/15	No change	60	No change
Ruby/Fuzzy	90/10	No change	0	No change

Note: [1]Night sorties are those flights that occur after sunset.
[2]Supersonic speed does not occur for the duration of the sortie.

Legend: ATCAA = Air Traffic Control Assigned Airspace; MOA = Military Operations Area.

Table 2.2-5 Proposed Chaff and Flare Usage – Alternative 2

MOA/ATCAA	Chaff Bundle Average Annual Usage		Flare Cartridge Average Annual Usage (minimum release altitude)	
	Existing (No Action)	Proposed	Existing (No Action)	Proposed
Tombstone	0	7,000	16,240 (5,000 feet AGL)	30,000 (2,000 feet AGL)
Outlaw/Jackal	17,690	24,560	19,050 (3,000 feet AGL)	26,460 (2,000 feet AGL)
Morenci/Reserve	13,950	16,920	13,460 (2,000 feet AGL: Morenci) (5,000 feet AGL; Reserve)	16,330 (No change to minimum release altitudes)
Gladden/Bagdad	14,390	19,050	15,570 (5,000 feet AGL)	20,610 (2,000 feet AGL)
Sells	31,490	37,890	34,560 (3,000 feet AGL)	41,580 (No change to minimum release altitude)
Ruby/Fuzzy	20,890	28,450	20,770 (2,000 feet AGL)	28,280 (No change to minimum release altitude)

Legend: AGL = above ground level; ATCAA = Air Traffic Control Assigned Airspace; MOA = Military Operations Area.

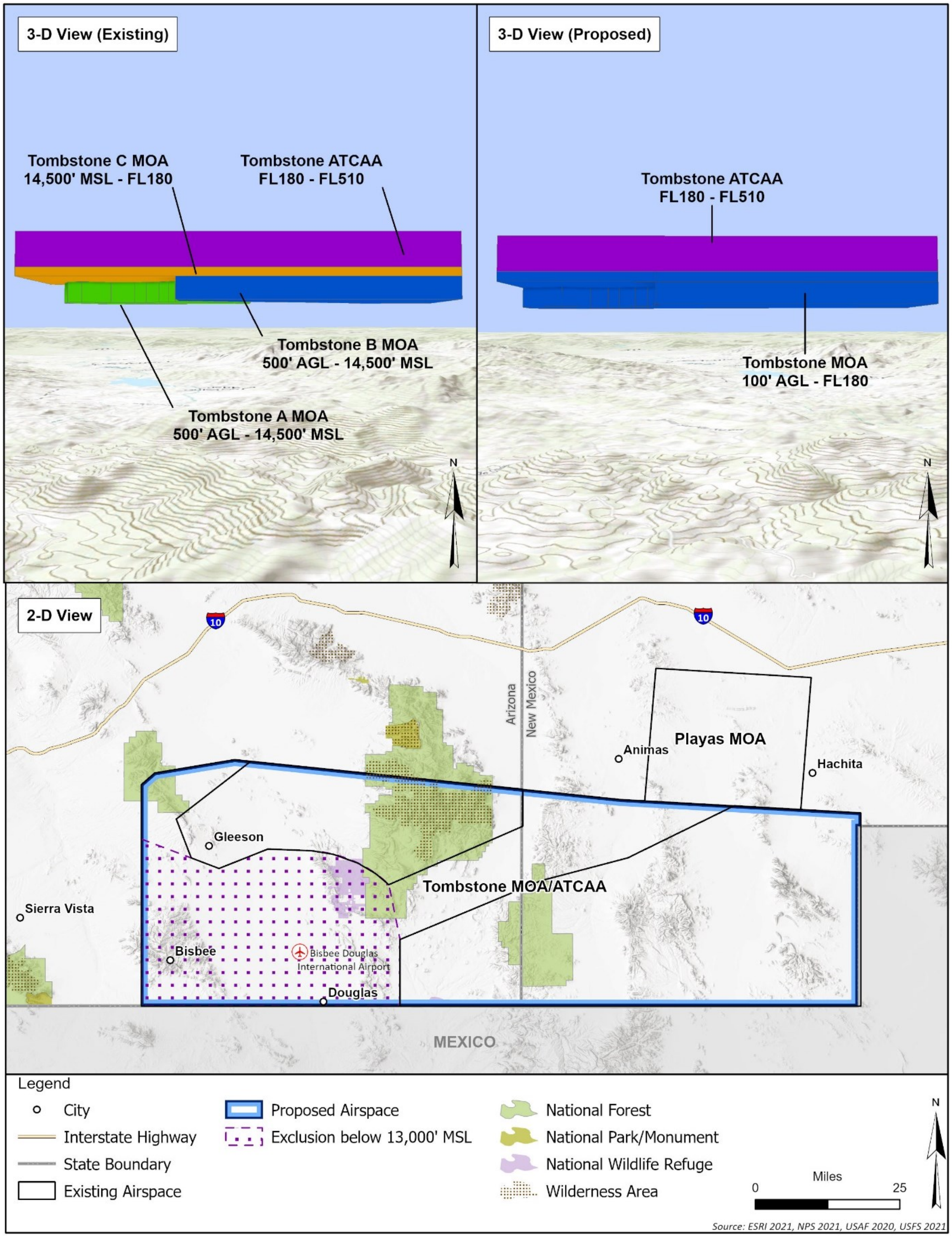
2.2.3 Alternative 3

Alternative 3 would alleviate training shortfalls and address evolving training needs of DAF aircrews by implementing the same proposed modifications as Alternative 2, except the northern expansion of approximately 10 nautical miles of Tombstone MOA/ATCAA would not occur. Tombstone A, B, and C would be combined, and the floor lowered to 100 feet AGL and extend up to but not including FL180 (**Table 2.2-6** and **Figure 2.2-1**). The Tombstone ATCAA would remain unchanged from the existing configuration. An exclusion below 13,000 feet MSL surrounding Bisbee Douglas International Airport would be established (same as Alternative 2). To increase the volume of airspace available to support Davis-Monthan AFB training needs down to 100 feet AGL, the floor of Jackal MOA would also be lowered to 100 feet AGL, consuming the existing Jackal Low MOA (**Figure 2.2-2**). This alternative also includes authorizing supersonic flight down to 5,000 feet in Tombstone, Outlaw, Jackal, Gladden, and Bagdad MOAs (same as Alternative 2).

Table 2.2-6 Summary of Proposed Altitude Changes – Alternative 3

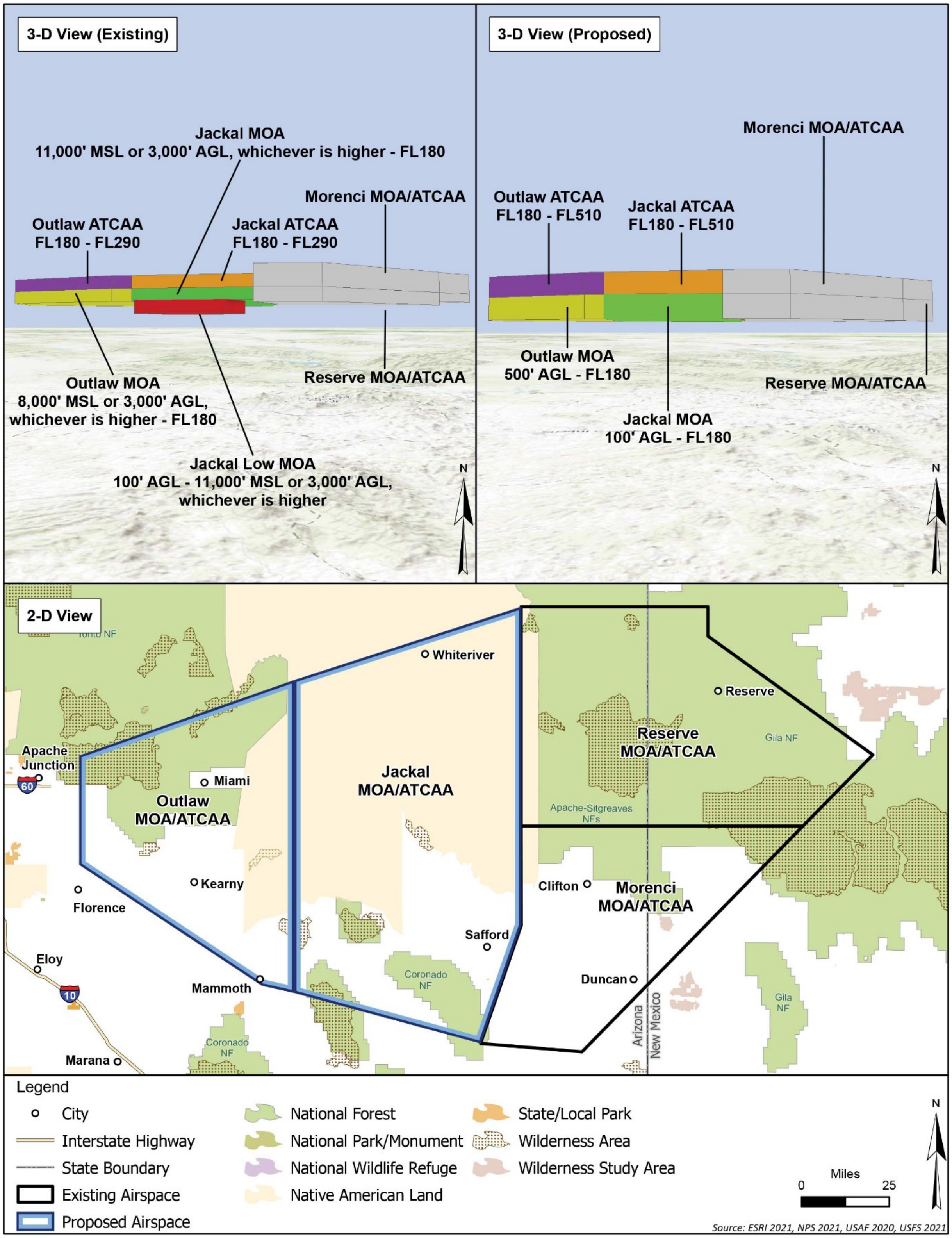
MOA	Existing Floor (No Action)	Proposed Floor
Tombstone	500 feet AGL	100 feet AGL
Outlaw	8,000 feet MSL or 3,000 feet AGL, whichever is higher	500 feet AGL
Jackal	11,000 feet MSL or 3,000 feet AGL, whichever is higher	100 feet AGL
Jackal Low	100 feet AGL	Removed
Morenci	1,500 feet AGL	No change
Reserve	5,000 feet AGL	No change
Bagdad	7,000 feet MSL or 5,000 feet AGL, whichever is higher	500 feet AGL
Gladden	7,000 feet MSL or 5,000 feet AGL, whichever is higher	500 feet AGL
Sells	10,000 feet MSL	No change
Sells Low	3,000 feet AGL	No change
Ruby	10,000 feet MSL	No change
Fuzzy	100 feet AGL	No change

Legend: AGL = above ground level; MSL = mean sea level; MOA = Military Operations Area.



Note: 3D Views are not to scale and are provided for illustrative purposes only.
Legend: AGL = above ground level; FL = Flight Level; MSL = mean sea level; MOA = Military Operations Area.

Figure 2.2-1 Proposed Tombstone MOA – Alternative 3



Note: 3D Views are not to scale and are provided for illustrative purposes only.
Legend: AGL = above ground level; ATCAA = Air Traffic Control Assigned Airspace; FL = Flight Level; MSL = mean sea level; MOA = Military Operations Area.

Figure 2.2-2 Proposed Jackal MOA – Alternative 3

The anticipated annual sorties and chaff and flare usage associated with Alternative 3 are provided in **Tables 2.2-7** and **2.2-8**. Alternative 3 affects sorties in Tombstone, Outlaw, and Jackal MOAs, all other operations would be the same as Alternative 2. The percentage of sorties occurring during the daytime vs nighttime and the percentage of sorties that include supersonic speed would be the same as detailed in Alternative 2, **Table 2.2-4**.

2.2.4 Alternative 4

Alternative 4 would alleviate training shortfalls and address evolving training needs of DAF aircrews by implementing the same proposed modifications as described for Alternative 2, except that supersonic flight would be authorized down to 10,000 feet AGL (instead of 5,000 feet AGL) in Tombstone, Outlaw, Jackal, Morenci, and Reserve MOAs (**Table 2.2-9**). Lowering the authorized altitude in the MOAs would improve the current capabilities; however, this option would not fully optimize the airspace for supersonic operations and not mirror real-world scenarios. Proposed sorties and chaff and flare usage would be the same as described in Alternative 2, **Tables 2.2-3**, **2.2-4**, and **2.2-5**.

2.3 ALTERNATIVES CONSIDERED BUT ELIMINATED

The DAF considered other alternatives to the Proposed Action but eliminated them from further analysis since they did not meet the purpose and need or selection standards defined in **Section 1.4**. Those alternatives and the reasons for eliminating from this EIS are as follows:

Expand hours of operation for BMGR East to support more training missions.

Normal hours for BMGR East are Monday through Friday, 0730 to 2330 Local. The range is open one to two weekends per month from 0800 to 1700 Local to support ANG and Air Force Reserve flying schedules. Expanding the hours of operation to support more training missions would only be possible by opening more weekends, essentially making BMGR operational 7 days a week with a commensurate increase in range support personnel. The aircrews in Arizona must train during the operational hours for their home bases, which currently are limited to weekdays. In addition to the pilots, a significant number of maintenance and other support staff must be present when the aircraft are operational. An alternative for a wholesale change of hours of pilot and ground support personnel and range support personnel would substantially increase costs. Expanding the hours of operation at BMGR to include more weekends would not fully alleviate the current capacity issues or the anticipated future capacity issues once all of the F-35s are based at Luke AFB. Also, expanding the hours of BMGR to support more operations would not meet the selection standard to reduce use of BMGR for non-hazardous training. Therefore, this was not considered a viable alternative.

Table 2.2-7 Proposed Annual Sorties – Alternative 3

MOA/ATCAA	No Action	Proposed									Change from No Action
		Davis-Monthan AFB	Morris ANGB	Luke AFB		Other[1]	Total Local	Transient[2]	Grand Total		
		A-10	F-16	F-16	F-35						
Tombstone	3,450	5,500	1,100	0	0	150	6,750	150	6,900		+ 3,450
Outlaw/Jackal	5,190	3,200	3,400	20	750	40	7,410	300	7,710		+2,520
Morenci/Reserve	3,350	850	2,900	0	150	0	3,900	150	4,050		+700
Gladden/Bagdad	6,920	20	0	1,600	7,300	0	8,920	200	9,120		+2,200
Sells	14,790	350	3,100	1,400	11,600	60	16,510	1,300	17,810		+3,020
Ruby/Fuzzy	5,490	2,300	4,200	20	850	40	7,410	200	7,610		+2,120

Notes: [1]Other includes non-fighter aircraft stationed in Arizona (EC-130Hs, HC-130Js, HH-60Gs).
[2]Transients include DAF units stationed outside Arizona and other U.S. military. Type of aircraft varies but can include other fighter aircraft such as AV-8B, F-35, F-22, and F-18; helicopters such as MV-22 and H-60; and cargo aircraft such as C-130.

Legend: AFB = Air Force Base; ANGB = Air National Guard Base; ATCAA = Air Traffic Control Assigned Airspace; DAF = Department of the Air Force; MOA = Military Operations Area.

Table 2.2-8 Proposed Chaff and Flare Usage – Alternative 3

MOA/ATCAA	Chaff Bundle Average Annual Usage		Flare Cartridge Average Annual Usage (minimum release altitude)	
	Existing (No Action)	Proposed	Existing (No Action)	Proposed
Tombstone	0	5,810	16,240 (5,000 feet AGL)	24,900 (2,000 feet AGL)
Outlaw/Jackal	17,690	25,750	19,050 (3,000 feet AGL)	31,560 (2,000 feet AGL)
Morenci/Reserve	13,950	16,920	13,460 (2,000 feet AGL: Morenci) (5,000 feet AGL; Reserve)	16,330 (No change to minimum release altitudes)
Gladden/Bagdad	14,390	19,050	15,570 (5,000 feet AGL)	20,610 (2,000 feet AGL)
Sells	31,490	37,890	34,560 (3,000 feet AGL)	41,580 (No change to minimum release altitude)
Ruby/Fuzzy	20,890	28,450	20,770 (2,000 feet AGL)	28,280 (No change to minimum release altitude)

Legend: AGL = above ground level; ATCAA = Air Traffic Control Assigned Airspace; MOA = Military Operations Area.

Table 2.2-9 Proposed Supersonic Flight Authorization – Alternative 4

MOA/ATCAA	Existing Minimum Altitude (No Action)	Proposed Minimum Altitude
Tombstone	FL300	10,000 feet AGL
Outlaw	FL300	10,000 feet AGL
Jackal	FL300	10,000 feet AGL
Morenci	FL300	10,000 feet AGL
Reserve	FL300	10,000 feet AGL
Bagdad	10,000 feet MSL	No change
Gladden	10,000 feet MSL	No change
Sells	10,000 feet MSL	No change
Ruby	Not authorized	No change
Fuzzy	Not authorized	No change

Legend: AGL = above ground level; ATCAA = Air Traffic Control Assigned Airspace; MOA = Military Operations Area; MSL = mean sea level.

Use simulators to meet training needs.

The use of simulators alone to overcome existing training shortfalls was eliminated as a reasonable alternative. Though simulation technology has provided increased realism over the years, simulators still lack the external environment realism, and the necessary level of fidelity or interoperability that provides new pilots with airmanship, critical thinking, and seasoning under real-world flight conditions. Simulators are currently used to the maximum extent possible within the objectives of each syllabus and provide good skills training that cannot be replicated accurately and/or safely in the aircraft, such as engine-out training. Therefore, use of simulators to overcome existing training shortfalls was not considered a reasonable alternative.

Optimize Sunny MOA

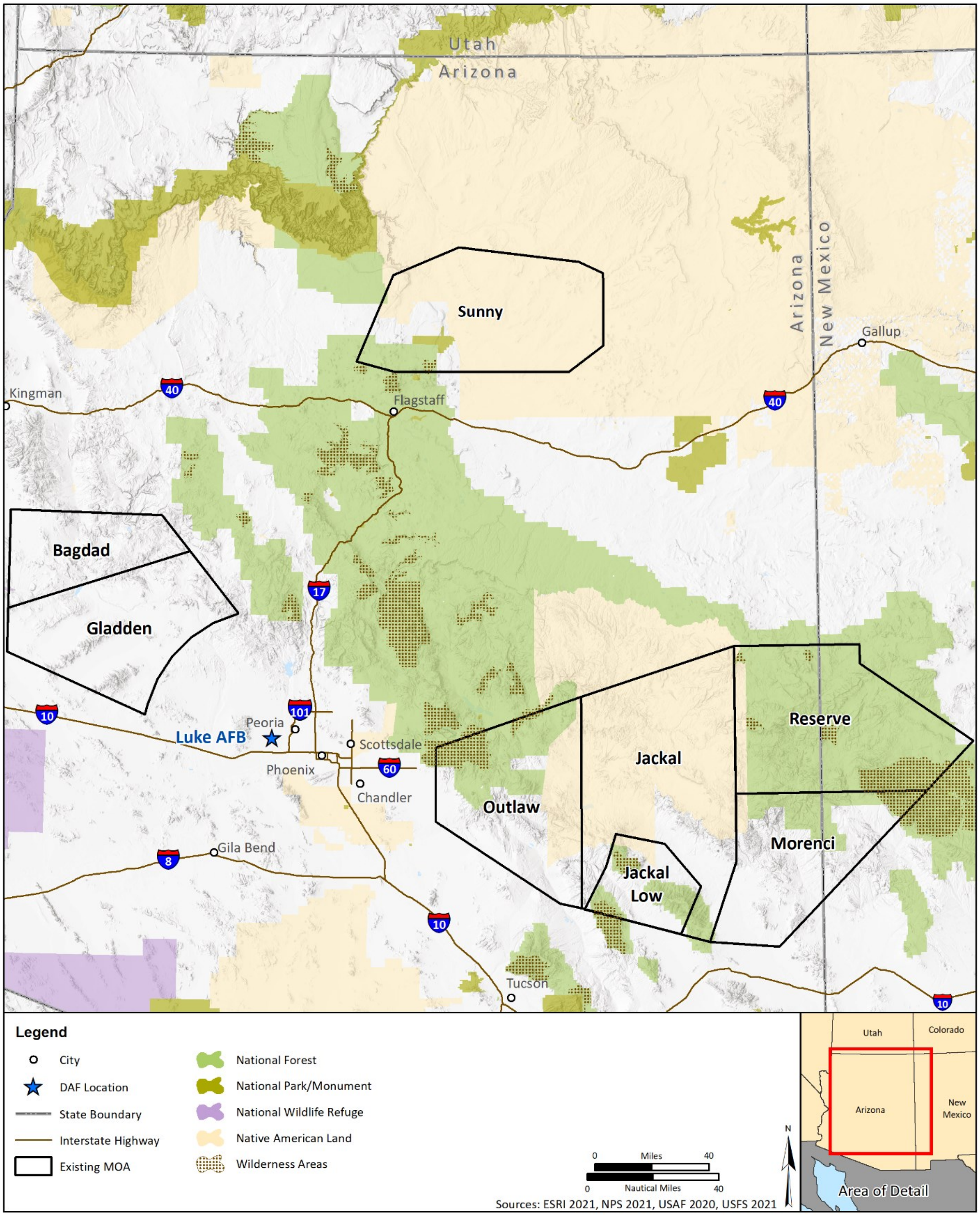
The DAF considered requesting modifications to Sunny MOA (located approximately 20 miles north of Flagstaff, Arizona, see **Figure 2.3-1**), including lowering the floor to 10,000 feet MSL or 3,000 feet AGL, whichever is higher, and authorizing supersonic operations down to 5,000 feet AGL. However, it was determined this MOA meets the altitude requirements for the training that currently occurs in this area. The optimization of MOA(s) closer to the base would better meet the low-altitude training requirements. Therefore, an alternative to lower the floor of Sunny MOA and authorize supersonic operations down to 5,000 feet AGL was eliminated from further consideration. The current use of the Sunny MOA will continue.

Lower Floor of Morenci and Reserve MOAs

The DAF considered requesting lowering the floors of Morenci and Reserve MOAs to 500 feet AGL. However, it was determined these MOAs meet the altitude requirements for the training that currently occurs or could occur in this area. The optimization of MOA(s) closer to the base would better meet the low-altitude training requirements of the F-16. Therefore, optimization of these MOAs was limited to lowering the altitude authorization for supersonic operations which are a training deficiency in the current MOAs. An alternative to lower the floor of these MOAs was eliminated from further consideration.

Reshape Outlaw, Jackal, Morenci, and Reserve MOA Complex

As noted in **Section 1.3.2**, *Regional Airspace Challenges*, departures from Phoenix Sky Harbor restrict use of the northern segment of Outlaw and Jackal MOAs. Although the existing LOA permits FAA to routinely schedule and use this segment, over time, the increased use by commercial aircraft has resulted in a near-permanent elimination of this area for military training. The reduction in the charted airspace has impacted the type of training that can occur in this MOA, effectively eliminating the possibility to perform 4 v 4 events. The DAF considered requesting a modification to the charted boundary of the Outlaw, Jackal, Morenci, and Reserve MOA complex to permanently return the northern portion to the NAS in exchange for additional airspace on the southern or southeastern boundary of the MOA complex which would address the training deficiency experienced in this area. While this alternative met the selection standards defined in **Section 1.4**, *Purpose and Need for Proposed Action*, moving the boundary of these MOAs to the south would cause issues with enroute and terminal flights into and out of Tucson International Airport. Therefore, this alternative was eliminated from further consideration.



Legend: AFB = Air Force Base; DAF = Department of the Air Force; MOA = Military Operations Area.

Figure 2.3-1 Sunny MOA

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3.0 AFFECTED ENVIRONMENT AND ENVIRONMENTAL CONSEQUENCES

3.1 INTRODUCTION

NEPA requires focused analysis of the areas and resources potentially affected by an action or alternative. This EIS focuses on those resources potentially affected by the proposal to modify the dimensions and altitudes of training airspace and conduct training missions to support DAF missions stationed in Arizona. The primary geographic Region of Influence (ROI) covered in this EIS is the lands beneath the MOA boundaries where training would occur as illustrated in **Figure 1.2-1** and beneath the proposed northern expansion of Tombstone MOA as illustrated in **Figure 2.1-1**. There are no changes proposed for any of the DAF installations, Davis-Monthan AFB, Luke AFB, or Morris ANGB; therefore, the land areas at these installations are not included in the ROI.

The Proposed Action does not include any proposed changes to the air traffic procedures at any of the installations or general operations within the regional airspace. The routes and altitude for aircraft transiting from the airfields at each installation to the MOAs would remain unchanged and are also above the 10,000 feet altitude generally used for determining the noise analysis per the FAA Order 1050.1F and the FAA Desk Reference (FAA 2023a). Therefore, the ROI in this EIS is the land beneath the training airspace boundaries.

3.1.1 Resources Not Carried Forward for Detailed Analysis

CEQ regulations (40 CFR 1501.9(a)) state that the lead agency should identify and eliminate from further study non-significant issues. **Table 3.1-1** addresses both DAF and FAA defined resources. A brief discussion for resources that were not carried forward for detailed analysis is provided for each resource after the table.

Table 3.1-1 Resources Analyzed in the EIS

Resource	Carried Forward for Detailed Analysis
Airspace Management and Use	Yes
Safety	Yes
Noise	Yes
Air Quality; Climate Change	Yes
Natural Resources	Yes
Land Management and Recreation	Yes
Socioeconomics	Yes
Environmental Justice	Yes
Cultural Resources	Yes
Hazardous Materials and Wastes	Yes
Visual Effects	Yes
Farmlands	No
Water Resources	No
Earth Resources	No
Natural Resources and Energy Supply	No
Coastal Zone	No

Farmlands. The Farmland Protection Policy Act regulates Federal actions with the potential to convert farmland to non-agricultural uses. The proposal would not involve any ground disturbance or conversion of farmland to non-agricultural uses; therefore, farmlands were not evaluated in detail in this EIS.

Water Resources. Water Resources include surface water, groundwater, wetlands, Wild and Scenic Rivers, and floodplains. The Proposed Action would be limited to the modification of airspace to support military training operations and would not include any components that would touch or directly affect the quantity, flows, percolation rate, or accessibility of surface or ground water resources. The use of chaff and flares does not affect water quality or aquatic habitats; see **Appendix F** for detailed information on chaff and flares. Wild and Scenic Rivers are addressed in **Section 3.7**, *Land Management and Recreation*.

Earth Resources. Earth Resources include geology, topography, and soils. The Proposed Action and alternatives would be limited to the modification of airspace to support military training operations. There are no activities proposed that would impact the geology, topography, or soils in the affected environment. The use of chaff and flares does not affect soil chemistry; see **Appendix F** for detailed information on chaff and flares.

Natural Resources and Energy Supply. A discussion of natural resources and energy supply is required under FAA NEPA guidance to determine a proposal's consumption of natural resources such as water, asphalt, aggregate, wood, etc., and use of energy supplies such as coal for electricity, natural gas for heating, etc. Consumption of natural resources and use of energy supplies would typically result from construction, operation, and maintenance activities of a proposed action. None of the alternatives evaluated in this EIS include the construction or maintenance of any facilities. The use of energy supplies would be jet fuel used during training operations; however, this is not expected to be a substantial increase or use of energy supplies beyond what is used currently. Therefore, natural resources and energy supply are not evaluated in detail in this EIS.

Coastal Zone. The Coastal Zone Management Act of 1972 was established to plan comprehensively for and manage development of the Nation's coastal land and water resources. There are no coastal zones within or near the ROI for this Proposed Action. Therefore, the Proposed Action and alternatives would not have any impact to coastal zone management.

3.1.2 Documents Incorporated by Reference

CEQ guidance encourages incorporating documents by reference that are sources of information for the EIS. These include documents of similar actions, analyses, or impacts that may apply to this Proposed Action. Documents incorporated by reference in part or in whole include:

Final F-35A Training Basing EIS (DAF 2012). A ROD was issued for this EIS that selected Luke AFB as the Air Force's first F-35A Pilot Training Center. The Final EIS provided the analysis that supports the decision of basing up to six F-35A training squadrons (144 aircraft) plus the two existing Foreign Military Sales F-16 squadrons (26 aircraft) at Luke AFB. The basing is expected to be complete by Fiscal Year 2025. At the time of the 2012 EIS, the Tactics, Techniques, and Procedures for the F-35 were not completed, and the extensive training needs were not fully known. Thus, the Basing EIS did not include any proposed modifications to SUA at any of the potential basing locations. This EIS is incorporated by reference since the basing at Luke AFB will occur regardless of the decision made on this EIS; therefore, the future operations of the F-35 within the regional airspace need to be accounted for in the No Action Analysis as well as the Proposed Action and alternatives.

Final Environmental Assessment for Playas Special Use Airspace (DAF 2021). A Finding of No Significant Impact (FONSI) was issued for the Air Force's proposal to establish a permanent MOA and ATCAA above Playas, New Mexico that would exist from 300 feet AGL up to but not including FL180, with an ATCAA above that extends to FL230. The MOA/ATCAA will be activated as needed to support multi-service training requirements and would be managed and scheduled by the 355 WG. This Environmental Assessment (EA) is incorporated by reference since the operations analyzed to occur in the southern half of the Playas MOA would need to be accounted for in the expanded Tombstone MOA associated with the Proposed Action in this EIS.

Programmatic Environmental Assessment for Implementation of Bird/Wildlife Aircraft Strike Hazard Management Procedures (DAF 2023a). The DAF prepared a programmatic EA to assess an adaptive approach to wildlife hazard management utilization short-, medium-, and long-term management strategies and non-lethal and lethal techniques, as deemed appropriate within the wildlife exclusion zone on DAF installations. The Proposed Action outlines Bird/Wildlife Aircraft Strike Hazard (BASH) management that supports unique DAF airfield operational and security requirements as well as airfield operation safety in general.

Programmatic Environmental Assessment for Testing and Training with Defensive Countermeasures (DAF 2023b). A FONSI was issued for the Programmatic EA to assess the continued use of legacy defensive countermeasures, their replacements, and the use of new defensive countermeasures in DAF testing and military training programs. This EA is a broad program-wide evaluation of the use of defensive countermeasures and the potential environmental consequences based on annual usage of these devices for a representative year at the time of preparation of the EA (2020). The geographic coverage for this EA includes all DAF ranges, restricted areas, warning areas, and MOAs to include all the MOAs addressed in this EIS. The EA builds on previously completed technical studies and environmental analyses which addressed various environmental conditions in sensitive environments that are representative of the range of environmental settings under all DAF test and training airspaces, including woodlands, desert, agricultural areas, oceans, grasslands, and wetlands. As part of this EA, the DAF developed an update to the 1997 and 2011 reports on defensive countermeasures (DAF 1997, 2011). The update describes the legacy and new defensive countermeasures in the DAF inventory and addresses primary environmental issues associated with chaff and flare deployment. The EA provides the basis for the Chaff and Flares Environmental Analysis in this EIS (**Appendix F**).

3.1.3 Past, Present, or Reasonably Foreseeable Actions

CEQ regulations (40 CFR 1502.16; 40 CFR 1508.1(g)) require that the environmental consequences of the Proposed Action consider cumulative impacts, which are effects on the environment that result from the incremental effects of the action when added to the effects of other past, present, and reasonably foreseeable actions regardless of what agency or person undertakes such other actions. Cumulative impacts can result from individually minor but collectively significant actions taking place over a period of time.

The first step in assessing cumulative impacts involves defining the scope of other actions and their interrelationship with the Proposed Action and alternatives (CEQ 1997). The scope must consider other projects that coincide with the location and timing of the Proposed Action. In this EIS, past, present, and reasonably foreseeable activities that have occurred, are occurring, or will occur in the vicinity of the MOAs have been identified.

In identifying past activities for cumulative impacts, agencies are not required to list the individual effects of past actions; rather they can focus "on the current aggregate effects of past actions" without providing details of those actions. CEQ (2005) states that cumulative effects analysis requires "a concise description of the identifiable present effects of past actions to the extent that they are relevant and useful in analyzing whether the reasonably foreseeable effects of the agency proposal…may have a continuing, additive, and significant relationship with those effects." In this EIS, past actions that altered the characteristics or the use of the MOAs are accounted for in the affected environment for each resource and thus have been included in the analysis for the Proposed Action and all the alternatives. The cumulative impacts analysis within each resource area focuses on those reasonably foreseeable actions that may cumulatively contribute to the consequences of the Proposed Action. A detailed list of the reasonably foreseeable actions is provided in **Appendix G**.

3.2 AIRSPACE MANAGEMENT AND USE

3.2.1 Resource Definition and Regulatory Framework

Airspace management and use considers how airspace is designated, used, and administered in a manner that best accommodates the individual and common needs of military, commercial, general aviation, and other users of the airspace.

In the U.S., airspace is managed and controlled by the FAA. The FAA is solely responsible for developing plans and policy for the use of airspace and for managing airspace in such a manner that it ensures the safety of flight and that all users of the NAS can operate in a safe, secure, and efficient manner (49 USC 40103[b]). The FAA considers multiple and sometimes competing demands for airspace in relation to airport operations, ATS Routes, military training airspace, and other special needs to determine how the NAS can best be structured to address all user requirements.

The DoD requests airspace from the FAA and schedules and uses airspace in accordance with the processes and procedures detailed in DoD Directive 5030.19, *DoD Responsibilities on Federal Aviation*, and FAA regulations. SUA identified for military and other governmental activities is charted and published by the National Aeronautical Charting Office in accordance with FAA Order JO 7400.2P, *Procedures for Handling Airspace Matters* (FAA 2023b). Airspace designated for military use is released to the FAA when the airspace is not needed for military requirements (DoD 2023). Descriptions of approved SUA, except temporary areas and controlled firing areas, are compiled and published once a year in FAA JO 7400.10, SUA. For MOAs which overlay public use airports, there is an airspace exclusion of 1,500 feet AGL and below within a 3 nautical mile radius of public use airports. This exclusion may be extended when necessary.

FAA Order 7400.2P indicates that the airspace review and approval process and environmental impacts review should be conducted concurrently as much as possible; however, they are still separate processes. FAA's approval of either the DoD's aeronautical (SUA) request or the DoD's NEPA analysis does not automatically confer approval of the entire proposal. See FAA Order JO 7400.2P, Chapter 21 (Sections 3, 4, 5, and 6) and Appendices 7 and 8 for additional details on the SUA request and approval process, and coordination between FAA and DoD of NEPA documentation for projects involving the use of SUA.

Procedures governing the use of training areas and airspace operated and controlled by the DAF are included in Air Force Policy Directive 13-2, *Air Traffic, Airfield, Airspace and Range Management* and its implementing regulations. The DAF manages airspace in accordance with processes and procedures detailed in Department of the Air Force Manual (DAFMAN) 13-201, *Airspace Management*. DAFMAN 13-201 also provides the guidance and procedures used to develop and process SUA actions. It governs airspace management instructions on creating and maintaining airspace that allows the DAF to meet operational needs for military readiness. DAF bases supplement regulatory guidance in local flying instructions in conjunction with LOAs with the FAA, which expand guidance for operations within airspace.

In accordance with FAA minimum safe altitudes (14 CFR 91.119), aircraft must avoid congested areas of a city, town, or settlement or any open-air assembly of people by 1,000 feet above the highest obstacle within a horizontal radius of 2,000 feet of the aircraft. Outside congested areas, aircraft must avoid persons, vessels, vehicles, or structures by 500 feet.

Any emergency flight that involves a life-flight transporting time-critical patients or donated organs receives priority status through any airspace unit when the pilot provides a call sign to the air traffic controller. FAA Order JO 7110.65AA, *Air Traffic Control*, states that operational priority is given to civilian air ambulance flights when verbally requested. Priority to life-flight status would not change with implementing the Proposed Action. Military training in the affected airspace would be stopped during such an event.

3.2.2 Affected Environment

The existing airspace and DAF operations associated with this EIS were introduced in Section 1.2. Detailed figures of the existing MOAs are provided in **Appendix C. Appendix H** provides introductory information on scheduling and general operating procedures as well as detailed descriptions and figures of airspace management features associated with each MOA. The Proposed Action does not include changes to the horizontal or vertical dimensions of the Sells, Ruby, Fuzzy, Morenci, or Reserve MOAs or their associated ATCAAs; therefore, airspace management would be unchanged within this airspace and will not be discussed further in this section. Additionally, the proposed change to published times of use in all MOAs is an administrative change to improve scheduling and does not imply an actual change in military aircraft use of the airspace from the existing conditions or result in impacts to airspace management and use. Therefore, this analysis focuses on the airspace where impacts to airports and civilian aviation would result from the proposed changes to MOA dimensions. An overview of the airports and ATS routes associated with the MOAs/ATCAAs with proposed dimensional changes is provided in this section.

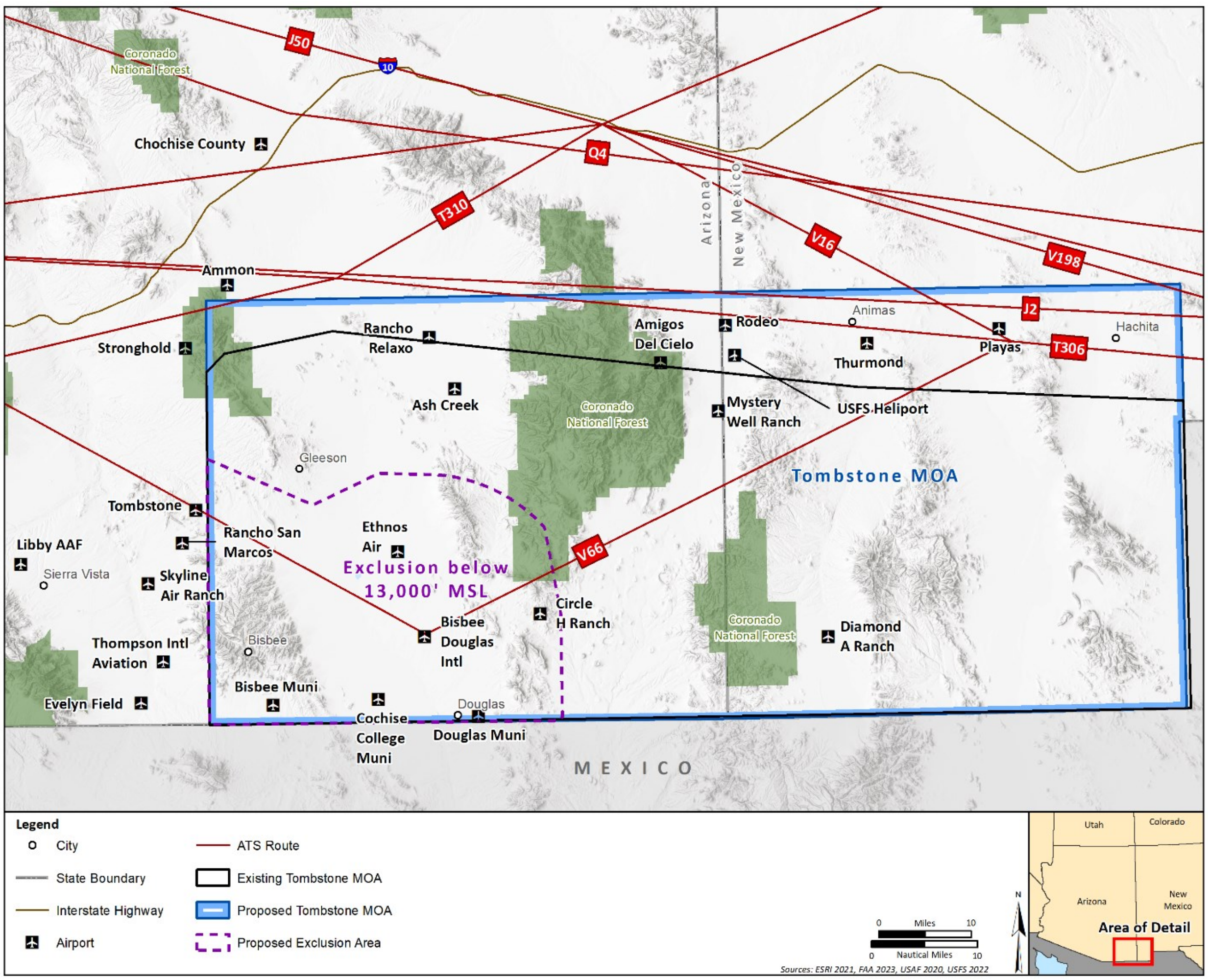
Table 3.2-1 provides a list of the ATS routes that pass through or near each MOA/ATCAA. **Figures 3.2-1 through 3.2-3** illustrate the airports beneath or in proximity to the MOAs and the ATS routes.

Table 3.2-1 ATS Routes within the MOAs

MOA	ATS
Tombstone A, B, C	V-66[1]
Tombstone Expansion	V-66 V-16 T-306 T-310 V-198 J-2 J-50 (outside boundary) Q-4 (outside boundary)
Outlaw and Jackal	None
Bagdad and Gladden	None

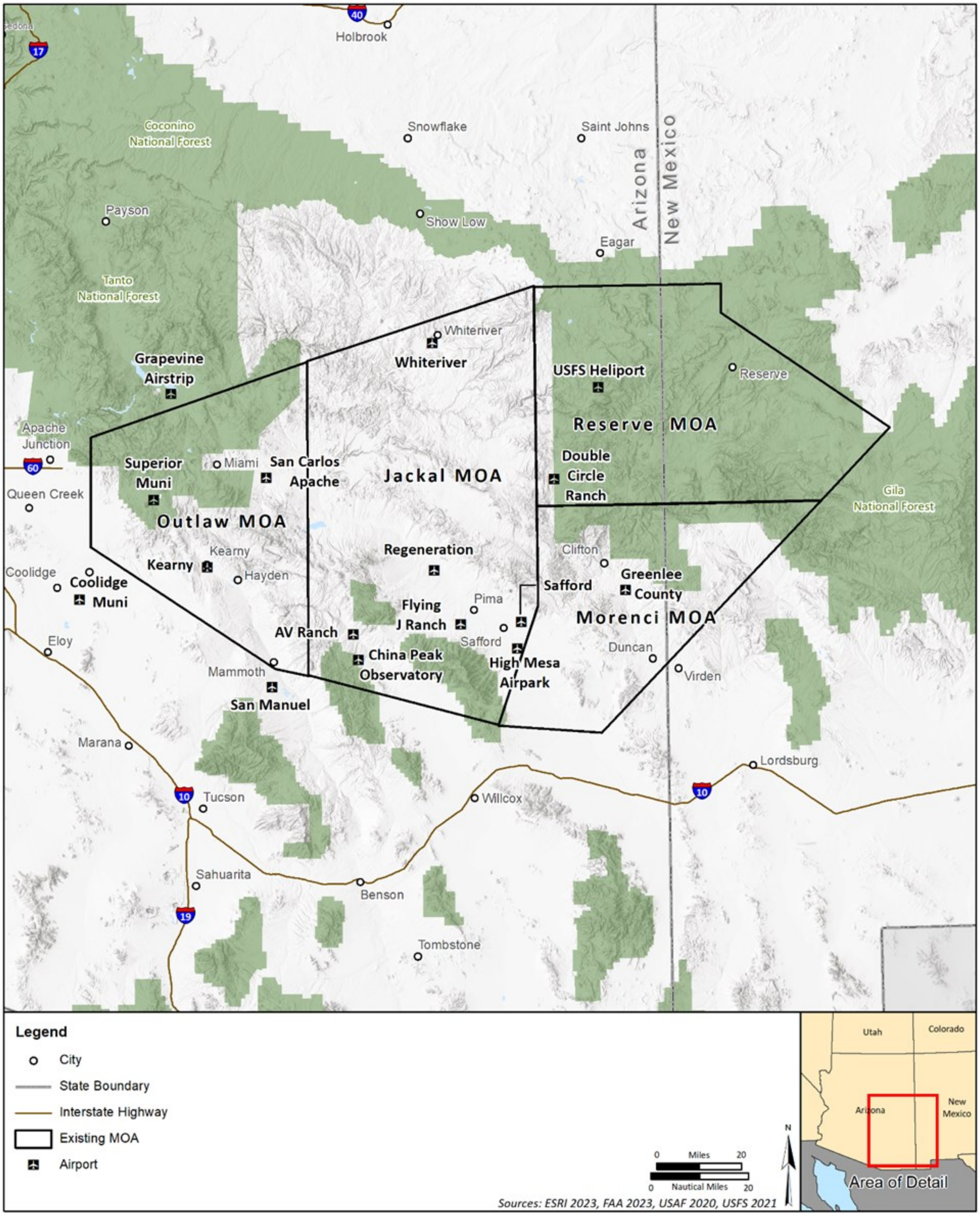
Note: [1]V-66 currently does not traverse through the MOAs. It exists in the corridor between Tombstone A and B, beneath the floor of Tombstone C. The Proposed Action is to combine these three spaces.

Legend: ATS = Air Traffic Service; MOA = Military Operations Area.



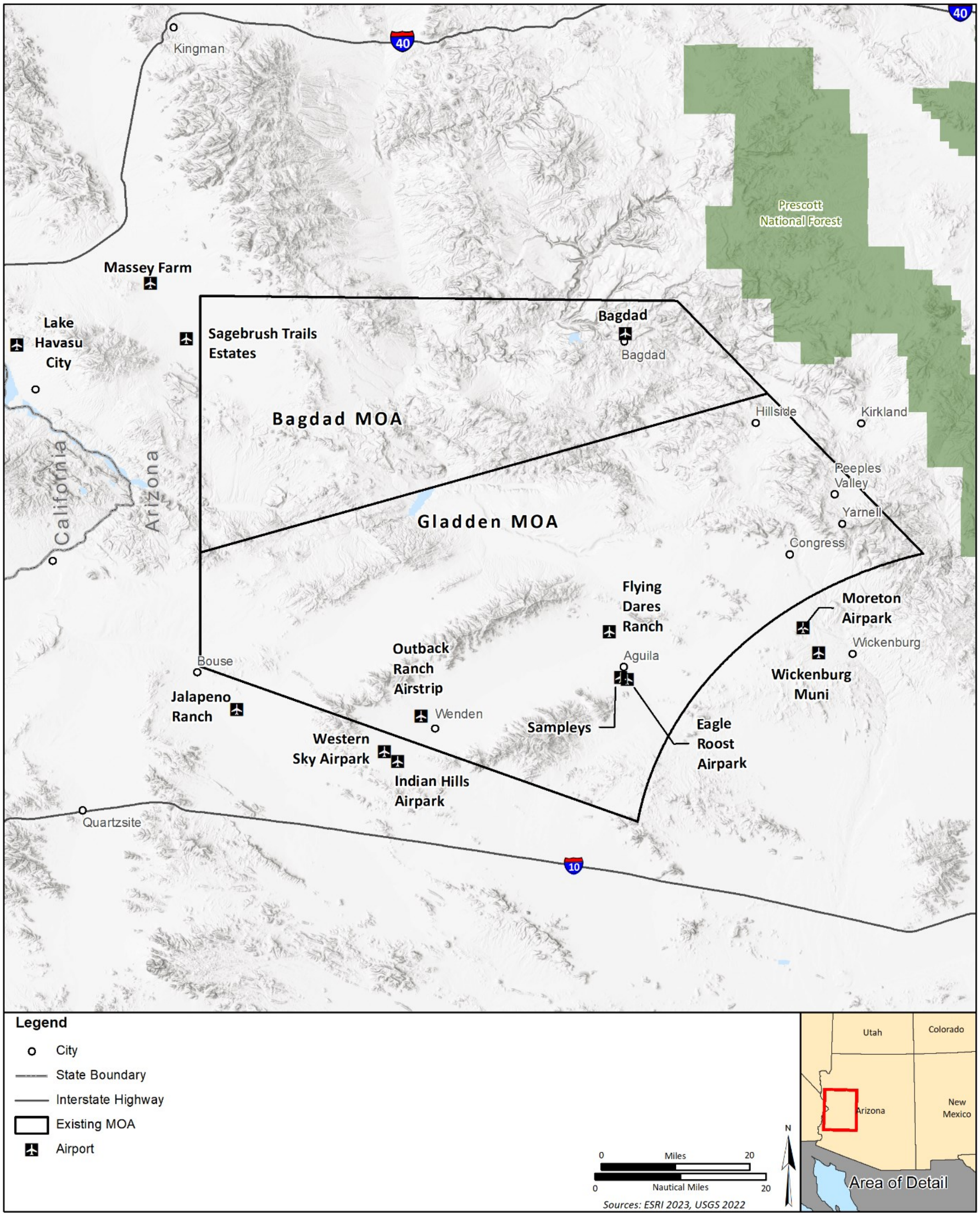
Legend: AAF = Army Airfield; MOA = Military Operations Area; MSL = mean sea level; USFS = U.S. Forest Service.

Figure 3.2-1 Public Airports, Civilian Airfields, and ATS Routes in the Vicinity of Tombstone MOA/ATCAA



Legend: MOA = Military Operations Area; USFS = U.S. Forest Service.

Figure 3.2-2 Public Airports and Civilian Airfields in the Vicinity of Outlaw and Jackal MOAs



Legend: MOA = Military Operations Area.

Figure 3.2-3 Public Airports and Civilian Airfields in the Vicinity of Bagdad and Gladden MOAs

3.2.3 Environmental Consequences

The airspace management analysis describes the potential effects to civilian air traffic and airports when compared to the existing environment. **Appendix H** provides a detailed technical analysis of the impacts to airports and civil users within the ROI for all alternatives. A summary of that analysis is provided in the EIS.

3.2.3.1 Alternative 1 – No Action

Under the No Action Alternative, training within the existing MOAs would continue and no modifications to existing airspace would occur. Airspace management and use would not change and there would be no additional effects to civilian air traffic and airports.

3.2.3.2 Alternative 2 – Proposed Action

The proposed dimensional changes to Tombstone, Outlaw, Jackal, Bagdad, and Gladden MOAs have the potential to impact instrument approach procedures and civil aviation. These impacts would only occur during times when the MOAs are active. The proposed times of use for all MOAs is detailed in **Section 2.1.1**, but it should be noted that the MOAs are not "active" for the entire time. **Appendix H** describes scheduling and activation, the data sources, methodology used to assess the impacts to civil aviation, and detailed technical analysis of the impacts. A brief summary of the impacts is provided in the EIS.

Impacts to Instrument Approach Procedures

The proposed changes to the Tombstone MOA and Outlaw/Jackal MOAs would impact instrument approach procedures to some local airports. None of the instrument approach procedures for airports beneath Bagdad/Gladden MOAs would be impacted.

Tombstone MOA

The proposed changes to the Tombstone MOA (expanded northern boundary) would impact instrument approach procedures at Cochise County Airport when the MOA is active. Cochise County Airport is located outside the boundaries of the proposed MOA; however, the missed approach procedure for Runway 3 requires aircraft to hold near the northern boundary of the proposed Tombstone MOA expansion. During times when the MOA is active, if a missed approach occurs, Air Traffic Control would have to issue alternate instructions or procedures. This impact would be minimal.

Outlaw/Jackal MOAs

The proposed lower floor in the Jackal and Outlaw MOAs would impact instrument approach procedures at Phoenix-Mesa Gateway and Coolidge Municipal Airports when the MOAs are active. Aircraft requiring these approaches would need to use a different initial approach fix during times when the MOAs are active and/or have the procedures modified.

Runway 30R at Phoenix-Mesa Gateway has an initial approach fix approximately 2 miles inside the boundary and beneath the proposed Outlaw MOA. The Runway 23 approach at Coolidge Municipal uses an initial approach fix approximately 1 mile inside the southern boundary of the Outlaw MOA and has an established standard holding pattern which extends to the northeast at 5,800 feet MSL. Aircraft requiring these approaches would need to use a different initial approach fix when the MOAs are active. These impacts would be minimal.

Impacts to Civil Aviation

Tombstone MOA/ATCAA

Approximately 17,600 civil aircraft flights annually traverse the entire area encompassing the proposed Tombstone MOA (which combines A, B, and C; lowers the floor to 100 feet AGL; and expands the northern boundary), during the proposed times of use (0600 to 2100 daily). Not all of these flights would represent new impacts from MOA operations as many of these occur in the existing MOA. Thus, the impacts analysis to civil aviation in the Tombstone MOA focuses on the proposed northern expansion, the Low ATCAA, the High North ATCAA, and the V-66 ATS route. For each of the flight tracks that crossed the proposed MOA/ATCAA, the origin and destination airport were identified and counted – providing a list of the number of flights per year traveling to and from each airport. The number of unique combinations of origin and destination airports is too large to provide meaningful individual analysis. The list was reduced to focus on the most frequently occurring airport origin-destination pairings, to represent the majority of traffic potentially affected by the proposed airspace modifications and produce a manageable and meaningful analysis. The impact to civil flights is described in terms of the additional travel time that would be required to avoid the active MOA/ATCAA.

Within the proposed Tombstone MOA northern expansion, approximately 2,900 civil flights traversed this area during the calendar year 2022. The average change in travel time to avoid the active MOA would be less than 1 minute, which would be a minimal impact. Moreover, if weather conditions allow for Visual Flight Rules (VFR), pilots have the option of proceeding through active MOAs. It is only IFR conditions that require flying around the active MOA.

Within the proposed Tombstone Low ATCAA (the portion associated with the northern expansion), approximately 1,200 civil flights traversed this area during the calendar year 2022. The traffic through this area is primarily east-west (or the reverse) and already includes routing necessary to avoid the White Sands Missile Range to the east and various other SUA in Arizona and New Mexico. The average change in travel time to avoid the active ATCAA would be less than 1 minute, which would be a minimal impact.

Within the proposed Tombstone High North ATCAA, approximately 8,100 civil flights traversed this area during calendar year 2022. As with the Low ATCAA, this traffic is primarily east-west. An additional factor in this dataset are various routes to Phoenix that are typically routed to avoid the existing MOA. A great number of those routes currently pass just north of the Tombstone MOA/ATCAA in the area proposed for the expansion. These routes would still have to be routed around the existing MOA, just slightly differently to avoid the proposed Tombstone High North ATCAA. In many cases, the new routing might be less than the current routing. The average change in travel time to avoid the active ATCAA would be less than 1 minute, which would be a minimal impact.

V-66 (minimum enroute altitude of 11,000 feet MSL) runs diagonally through the corridor between the existing Tombstone A and B MOAs beneath the Tombstone C MOA. Approximately 280 civil flights traversed this corridor during calendar year 2022 (approximately 23 per month), most of which was VFR traffic. Rerouting these flights around the west side of Tombstone MOA would add approximately

12 nautical miles and 4 to 5 minutes to the flight time, depending on the type of aircraft. For aircraft departing and arriving from the east at Douglas Bisbee International, the reroute around Tombstone MOA would cause a larger impact of up to a total travel distance of 241 nautical miles, or an additional 25 minutes to the overall travel time. This impact implies the need for a procedure (i.e., specific location and/or altitudes) to allow aircraft that currently fly in this general corridor to transit the new Tombstone MOA when active. The impacts would apply to both IFR aircraft, and those VFR aircraft which choose to go around the MOA. If weather conditions allow for VFR, pilots have the option of proceeding through active MOAs. It is only IFR conditions that require flying around the active MOA.

Outlaw/Jackal MOAs

Approximately 25,500 civil aircraft flights occurred annually within the proposed Outlaw/Jackal MOAs beneath 11,000 feet MSL during the proposed times of use (0600 to 2200, Monday through Friday) and a large majority of those operations (approximately 80 percent) were beneath Outlaw MOA. Approximately 50 percent of the flight tracks had unknown origins and destinations, indicating they were likely VFR. The origin and destination airports for known flight tracks were identified and counted. An analysis of the pairings revealed that most of the flight tracks in this dataset were originating and departing from the same four locations southeast of Phoenix Sky Harbor International Airport (Falcon Field Airport, Phoenix-Mesa Gateway Airport, Chandler Municipal Airport, and Safford Regional Airport). The vast majority of the aircraft activity were flights taking off from one of these airports, flying beneath the Outlaw/Jackal MOA, and returning to the same airport. Very few of these flights were passing through the airspace going to a further destination. Therefore, rerouting was not a feasible analysis for this dataset.

All these airports offer pilot instruction services or have flight training schools; therefore, it is assumed the vast majority of the operations in this area are associated with student pilot training activities. A segment of the Southeast Practice Area exists beneath the existing Outlaw MOA (Arizona Flight Training Working Group 2022). While VFR traffic is not prohibited from entering an active MOA, most VFR traffic, especially student pilots, may choose to avoid an active MOA for safety reasons. Lowering the floor of the Outlaw MOA specifically would conflict with the existing pilot training that occurs in this area.

Bagdad/Gladden MOAs

Approximately 6,975 civil aircraft flights annually traverse the proposed Bagdad/Gladden MOAs below 7,000 feet MSL during the proposed times of use (0600 to 0000, Monday through Friday). For each of the flight tracks that crossed the proposed MOAs, the origin and destination airport were identified and counted providing a list of the majority of airport pairings most likely impacted. For each of those pairings, the distance and time required to reroute around the active MOA was calculated. Rerouting around the MOA would vary depending on the flight track but would range from less than 1 minute to 7 minutes.

A large number of flights transiting these MOAs were arriving or departing at three airports with known flight training schools. Therefore, it is assumed a number of the flight operations are associated with student pilot training. The Embry Riddle Aeronautical University operates out of Prescott Regional Airport and their training area overlaps the eastern edge of the Bagdad/Gladden MOA complex. A portion of the Kirkland Junction and Semi-Circle Ranch training areas are beneath the eastern portions of Bagdad/Gladden MOA complex and extend from 500 feet AGL to 14,000 feet MSL. The Lufthansa Training Area encompasses approximately one-third of the southwestern portion of the Gladden MOA. While VFR traffic is not prohibited from entering an active MOA, most VFR traffic, especially student pilots, may choose to avoid an active MOA for safety reasons. Lowering the floor of the Bagdad/Gladden MOAs would conflict with the existing pilot training that occurs in this area.

3.2.3.3 Alternative 3

Impacts to Instrument Approach Procedures

Tombstone MOA

Under Alternative 3, the proposed northern expansion of the Tombstone MOA would not occur. There would be no impact to any approach procedures beneath or near the Tombstone MOA.

Jackal/Outlaw

The proposed lower floor in the Jackal (down to 100 feet AGL) and Outlaw (down to 500 feet AGL) MOAs would impact instrument approach procedures at Phoenix-Mesa Gateway and Coolidge Municipal when the MOAs are active. These impacts would be the same as Alternative 2 – Proposed Action.

Impacts to Civil Aviation

Tombstone MOA

The potential impacts to civil aviation associated with V-66 under Alternative 3 would be the same as described for Alternative 2 – Proposed Action. Alternative 3 does not include the northern expansion; therefore, there would be no impact to east-west civilian flights in the proposed expansion area.

Outlaw/Jackal MOAs

The potential impacts to civil aviation would be the same as described under Alternative 2 – Proposed Action.

Bagdad/Gladden

The potential impacts to civil aviation would be the same as described under Alternative 2 – Proposed Action.

3.2.3.4 Alternative 4

Alternative 4 is the same as Alternative 2, except this alternative limits supersonic operations down to 10,000 feet AGL in the Tombstone, Outlaw, Jackal, Morenci, and Reserve MOAs as opposed to 5,000 feet AGL. The impacts to airspace management and civil users would be the same as described for Alternative 2 – Proposed Action.

3.2.4 Cumulative Impacts

An EA and FONSI to establish the Playas MOA as a permanent MOA was completed in 2021. The current Playas MOA overlaps the proposed northern expansion of the Tombstone MOA. Under Alternatives 2 and 4, the southern half of the Playas MOA would overlap or be consumed by the new Tombstone MOA. The DAF (Davis-Monthan AFB) schedules both MOAs and would be responsible for deconflicting use of both of these MOAs. A cumulative impact to airspace management is not expected.

One of the Asarco mine sites (Hayden and Ray) is located beneath the Outlaw MOA. The mine uses Unmanned Aerial Systems to monitor mining operations and are approved to fly up to 1,200 feet AGL above the mine site. Lowering the floor of the Outlaw MOA (down to 500 feet AGL) would overlap the Unmanned Aerial Systems operating area. There is an existing Military Training Route (VR-263) with a 300-foot floor over the mine and deconfliction methods are currently prescribed in Asarco's approved Part 107 waiver. These existing deconfliction measures would continue with implementation of the Proposed Action or any alternative and a cumulative impact is not anticipated.

3.2.5 Mitigations

Measures to avoid or reduce significant airspace management impacts would be developed through coordination with FAA as the agency responsible for the NAS. Specific mitigations would be developed during their aeronautical review process which includes a safety risk analysis and public review period as defined in FAA Order JO 7400.2P, *Procedures for Handling Airspace Matters*. That process occurs concurrently with the NEPA process and any mitigations identified will be included in the Final EIS.

3.3 SAFETY

3.3.1 Resource Definition and Regulatory Framework

This section addresses flight and ground safety associated with activities conducted by units operating within the existing and proposed Tombstone, Outlaw, Jackal, Morenci, Reserve, Bagdad, Gladden, Sells, Ruby, and Fuzzy MOAs. Flight safety considers aircraft flight risks such as aircraft mishaps, BASH, and use of chaff and flares. Ground safety includes activities associated with crash response and fire risk and management.

The DAF practices Operational Risk Management as outlined in DAFI 91-202, *The U.S Air Force Mishap Prevention Program*. Requirements outlined in this document provide for a process to maintain readiness in peacetime and achieve success in combat while safeguarding people and resources. Military training airspace is complex; AFMAN 13-212V1, *Range Planning and Procedures*, outlines the risk management process and safety during and prior to any change to range operations, boundaries, or procedures. The safety analysis contained in the following sections addresses issues related to the health and well-being of both military personnel and civilians under the training airspace. The FAA is responsible for ensuring safe and efficient use of U.S. airspace by military and civilian aircraft and for supporting national defense requirements. To fulfill these requirements, the FAA has established safety regulations, airspace management guidelines, a civil-military common system, and cooperative activities with the DoD. An airspace obstruction analysis is included in **Appendix I**.

3.3.2 Affected Environment

3.3.2.1 Flight Safety

Aircraft flight operations in the MOAs and ATCAAs are governed by standard rules of flight. Additionally, specific procedures applicable to local operations are contained in installation Standard Operating Procedures (SOPs) and must be adhered to by all aircrews operating from each installation.

The primary safety concern regarding military training flights is the potential for aircraft mishaps (i.e., crashes) to occur, which could be caused by mid-air collisions with other aircraft or objects, weather difficulties, mechanical failures, pilot error, or bird/wildlife aircraft strikes. Flight risks apply to all aircraft, and it is not limited to military flight. Flight safety considerations addressed in this EIS are aircraft mishaps, bird/wildlife aircraft strikes, and use of chaff and flares.

Aircraft Mishaps

Aircraft mishaps are classified as A, B, C, or D (**Table 3.3-1**). Class A mishaps are the most severe with total property damage of $2.5 million or more or a fatality and/or permanent total disability. Comparison of Class A mishap rates for various aircraft types, as calculated per 100,000 flying hours, provides the basis for evaluating risks among different aircraft and levels of operations.

Table 3.3-1 Aircraft Mishap Classifications

Mishap Class	Total Property Damage	Fatality/Injury
A	$2,500,000 or more and/or aircraft destroyed	Fatality or permanent total disability
B	$600,000 or more but less than $2,500,000	Permanent partial disability or three or more persons hospitalized as inpatients
C	$60,000 or more but less than $600,000	Nonfatal injury resulting in loss of one or more days from work beyond day/shift when injury occurred
D	$25,000 or more but less than $60,000	Recordable injury or illness not otherwise classified as A, B, or C

Source: Air Force Safety Center 2022.

Based on historical data on mishaps at all installations and under all conditions of flight, the military services calculate Class A mishap rates per 100,000 flying hours for each type of aircraft in the inventory to provide the basis for evaluating risks among different aircraft and levels of operations. These mishap rates do not consider combat losses due to enemy action. The predominant aircraft operating within the MOAs are DAF fighter aircraft, A-10, F-16, and F-35s stationed at Arizona bases. Collectively, these aircraft have flown more than 17,600,000 hours. The available historical data on hours flown for each of these aircraft dates back to 1972 for A-10s, 1975 for F-16s, and 2012 for F-35s. Based on the historical data, 495 Class A mishaps have occurred, and 448 aircraft have been destroyed. This results in an average Class A mishap rate of 2.45 per 100,000 flight hours, and an aircraft destroyed rate of 5.21 across all three airframes (Air Force Safety Center [AFSEC] 2021). These statistics include DoD activities at locations worldwide and is not specific to mishaps in the Arizona or New Mexico ROI.

Bird/Wildlife Aircraft Strike Hazard

Bird/wildlife aircraft strikes constitute a safety concern because they can result in damage to aircraft or injury to aircrews, or the local population in the event of an aircraft crash. Aircraft may encounter birds at higher altitudes; however, most birds fly close to the ground. Of the reported phases of flight during bird strikes, approximately 31 percent occur in the airport environment (e.g., final approach, landing, takeoff, initial climb, traffic pattern); and about 9 percent occur during other low-level, air, or enroute operations. The historical data indicate that there are fewer occurrences in other phases of flight such as air-to-air operations, aerial refueling, flight demonstrations, and aerial delivery operations. Approximately 50 percent of the recorded instances of bird strikes are not associated with a particular phase of flight (AFSEC 2019). These bird strike statistics include Air Force activities at locations worldwide and not specific to strikes in the Arizona or New Mexico ROI. The Proposed Action would involve air-to-air and similar phases of flight.

Migratory waterfowl (e.g., ducks, geese, and swans) are the most hazardous birds to low-flying aircraft because of their size and their propensity for migrating in large flocks at a variety of elevations and times of day. Waterfowl vary considerably in size, from 1 to 2 pounds for ducks, 5 to 8 pounds for geese, and up to 20 pounds for most swans. There are two normal migratory seasons, fall and spring. Waterfowl are usually only a hazard during migratory seasons. These birds typically migrate at night and generally fly between 1,500 to 3,000 feet AGL during the fall migration; and, from 1,000 to 3,000 feet AGL during the spring migration.

In addition to waterfowl, raptors, shorebirds, gulls, herons, songbirds, and other birds also pose a hazard. In considering severity, the results of bird aircraft strikes in restricted areas show that strikes involving raptors result in the majority of Class A and Class B mishaps related to bird aircraft strikes. The vast mountainous terrain beneath the training airspace used by Arizona aircrews is subject to bird activity. Peak migration periods in Arizona for raptors, especially eagles, are from October to mid-December and from mid-January to the beginning of March. In general, flights above 1,500 feet AGL would be above most migrating and wintering raptors. Songbirds are small birds, usually less than 1 pound. During nocturnal migration periods, they navigate along major rivers, typically between 500 to 3,000 feet AGL. The potential for bird aircraft strikes is greatest in areas used as migration corridors (flyways) or where birds congregate for foraging or resting (e.g., open water bodies, rivers, and wetlands).

While any bird aircraft strike has the potential to be serious, only a small portion result in Class A mishaps. From 2000–2019, the reported Class A mishaps across all Air Force locations worldwide resulting from bird strikes were 34 (AFSEC 2020). Arizona range operations require monitoring bird activity and bird strike risk levels for the airspace associated with the operations area (DAF 2023b). Local operations plans at the Arizona bases restrict operations over geographical areas and land features where birds have been identified to altitudes higher than 1,000 feet AGL (DAF 2013). The DAF maintains the Avian Hazard Advisory Safety System (AHAS) to detect and assess the risk of a bird strike. AHAS uses three products or data sources to assess the risk of a bird strike (AFSEC 2015). The primary source of the risk assessment is data downloads from Next Generation Radar stations as soon as they become available from the National Oceanic Atmospheric Administration. These stations update every 4–10 minutes. The second source for risk assessment is the soar risk. This risk uses weather data and the known populations of soaring species of birds to determine the risk. This data is available every 12 hours and the risk is projected out 24 hours. The third source for the risk assessment is the Bird Avoidance Model which consists of geographic information system raster grids spanning the continental U.S. and Alaska. The value for each cell is equivalent to the sum of the mean bird mass for all species present during a particular daily time period. Pilots stationed in Arizona are required to check AHAS prior to all flights. AHAS, together with each unit's BASH Management Plan, are used to assess local and enroute bird strike risks and manage flight operations on low level routes, training ranges, and SUA (DAF 2013; ANG 2019).

Chaff and Flare Usage

Refer to **Appendix F** for detailed descriptions of chaff and flares and the potential environmental impacts associated with the use of chaff and flares. The primary airspace safety issue related to chaff deployment is the potential to interfere with air traffic control radar. Potential radar conflicts are typically avoided since the standard practice is to obtain a frequency clearance from the Air Force Frequency Management Center and Headquarters FAA prior to chaff use (DAF 1997). Additionally, FAA JO 7110.65AA provides guidance for issuing chaff advisories to potentially affected aircraft or stopping such activities when necessary. The RR-188 training chaff is the only type of chaff used in the airspace addressed in this EIS. This type of training chaff has dipole fibers removed, thereby eliminating interference with FAA radar tracking systems and has been approved for use by the FAA. Currently, chaff is authorized for use and is deployed in all MOAs except Tombstone MOA. The proposed use of training chaff in Tombstone MOA would not interfere with radar and would have no potential to affect flight safety.

The use of flares is performed in accordance with applicable DAF safety regulations, published Air Force Technical Orders, and standards prescribed by Air Force Occupational Safety and Health requirements. Flare deployment in authorized airspace is governed by a series of regulations that are based on safety and environmental considerations and limitations. Among these regulations are the following:

- DAFMAN 13-201 establishes practices to decrease disturbances from flight operations and protect the public from the hazards and effects associated with flight operations.
- AFMAN 13-212V1 outlines procedures governing weapons range use of flares.
- AFI 11-214 delineates procedures for flare employment.

Flares are currently used in all MOAs in accordance with all applicable regulations. The Proposed Action would lower the minimum release altitude in some MOAs; however, this would be in compliance with existing regulations. Thus, the proposed use of flares would not change any flight safety procedures. Fire safety risks from flares is discussed in ground safety (**Section 3.3.2.2**).

3.3.2.2 Ground Safety

Ground safety includes activities and procedures associated with crash response and fire risk management from aircraft mishaps and flare use.

Crash Response

All of the affected DAF bases maintain detailed emergency and mishap response plans to react to an aircraft accident, should one occur. These plans assign agency responsibilities and prescribe functional activities necessary to react to major mishaps, whether on or off base. Response would normally occur in two phases. The initial response focuses on rescue, evacuation, fire suppression, safety, elimination of explosive devices, ensuring security of the area, and other actions immediately necessary to prevent loss of life or further property damage. This consists of those personnel and agencies primarily responsible for initiating the initial phase. This element will include the Fire Chief, who will normally be the first On-scene Commander, firefighting and crash-rescue personnel, medical personnel, security police, and crash-recovery personnel. For operations within the MOAs, where there is a designated Range Control Officer, they assume the role of the On-scene Commander until the crash response team can be organized. A subsequent response team will be comprised of an array of organizations whose participation will be governed by the circumstances associated with the mishap and actions required to be performed. Subsequently, the second, or investigation phase, is accomplished.

Regardless of the agency initially responding to the accident, efforts are directed at stabilizing the situation and minimizing further damage. If the accident has occurred on non-Federal property, a National Defense Area may be established around the accident scene and the site would be secured to protect classified information or DoD equipment and/or material for the investigation phase.

After all required investigations and related actions on the site are complete, the aircraft would be removed. The Base Civil Engineer accomplishes cleanup of the site or contracts to an outside agency to accomplish the cleanup. Overall, the purpose of response planning is to:

- save lives, property, and material by timely and correct response to mishaps;
- quickly and accurately report mishaps to higher Headquarters; and
- investigate the mishap to preclude the reoccurrence of the same or a similar mishap.

Fire Risk

Fire risk associated with flares stems from an unlikely, but possible, scenario of a flare reaching the ground or vegetation while still burning. If a flare struck the ground while still burning, it could ignite surface material and cause a fire. Defensive flares typically burn out in 3.5 to 5 seconds, during which time the flare will fall between 200 and 400 feet. The best way to reduce the risk of fires caused by flares is to establish and enforce minimum altitudes for flare release. Minimum flare release altitudes are established to ensure public health and safety and 2,000 feet AGL is the standard release altitude over non-Federal land. It is the responsibility of the Wing Commander to develop policy to ensure public and pilot safety during operations within the MOA. Implementing restrictions on the use of flares based on local fire conditions is a best management practice that is currently implemented for each MOA and is defined in individual unit policies. These restrictions vary depending on the local conditions beneath the MOA and would continue as part of the Proposed Action.

The land area under the existing and proposed MOAs/ATCAAs is owned or managed by a variety of separate entities, including Bureau of Land Management (BLM) and the USFS as well as tribes. Fire suppression of wildland fires on Federal lands is the responsibility of the entity that owns/manages that land and is geared toward protecting lives and suppressing wildfire.

The USFS maintains fire incident data back to 1992. From 2016 to 2020, there were 3,160 recorded fire incidents beneath the existing airspace for the Tombstone, Bagdad/Gladden, Outlaw/Jackal, Morenci/Reserve, Fuzzy/Ruby/Sells MOAs (Short 2022). Of the 3,160 incidents that occurred below the 10 MOAs, the highest occurrence was beneath Jackal where 1,362 fires were reported. Of the total reported fires, 1,083 (34 percent) were caused by human factors such as arson, debris, and open burning with arson accounting for the highest percentage of causal factors (Short 2022). Although there was some initial speculation that the 2021 Telegraph fire may have been caused by flares from Morris ANGB based F-16s, the DAF is not aware of a probable cause determination stating such and the few F-16s in that area that day were operating at much higher than minimum flare drop altitudes. The DAF believes it is unlikely that the fire was caused by flares from F-16s.

3.3.3 Environmental Consequences

3.3.3.1 Alternative 1 – No Action

Under the No Action Alternative, pilot training in the MOAs would continue to occur in the existing MOAs as it currently does. There would be no changes to the horizontal or vertical dimensions of the MOAs. Current operations and training activities in the existing MOAs/ATCAAs do not pose a significant safety risk to the public, military personnel, or property. Procedures in place for flight safety (mishaps, BASH, and chaff and flare usage) and ground safety (crash response and fire risk management) would continue as described in **Section 3.3.2**, *Affected Environment*.

3.3.3.2 Alternative 2 – Proposed Action

Flight Safety

Under the Proposed Action, all flight activities would continue to be conducted in accordance with applicable regulations, Technical Orders, and Air Force Occupational Safety and Health standards described in **Section 3.3.2.1**, *Flight Safety*. There would be no aspects of the Proposed Action that would be expected to create new or unique flight safety issues or create additional risk in any of the MOAs/ATCAA. Therefore, minimal safety risk is expected.

Aircraft Mishaps

It is impossible to predict the precise location of an aircraft accident; however, the probability of an aircraft crashing into a populated area is extremely low. Several factors are relevant: the land beneath the MOAs and immediate surrounding areas have relatively low population densities; pilots of aircraft are instructed to avoid direct overflight of population centers at very low altitudes; and, finally, the limited amount of time the aircraft is over any specific geographic area limits the probability that a disabled aircraft would impact a populated area.

As stated in **Section 3.3.2.1**, *Flight Safety*, the average Class A mishap rate across the lifetime of F-16/F-35/A-10 is 2.45 mishaps per 100,000 flight hours (AFSEC 2021). The type of training proposed would be the same as what is performed currently, and there would be no aspect of the Proposed Action that would increase the potential accident rate.

A Class A mishap can also result in metal debris on the ground. The extent of the debris field depends upon the aircraft accident. Both to identify the cause of the accident and for restoring the accident site as much as possible, the DAF would make every effort to locate, document, and then clean up debris resulting from any accident.

As aircraft move through the air, they create vortices from their wing tips. These vortices, collectively called wake turbulence, form as the air passes both over and under the wing tips. The pressure differential caused by the passing of air over and under the wings generates lift with the lowest pressure above the wing and the highest pressure under it. Due to this differential, a "rollup" of the airflow occurs behind the wing causing swirling air to trail from the wing tips. The rollup process produces a wake consisting of a counterrotating vortex extending from each wing tip (FAA 2014). Aircraft begin to generate vortices as soon as the nose wheel lifts off the surface of the runway and continues until the nose wheel touches down during landing.

A complex set of variables and conditions influence the behavior and persistence of vortices. These variables include aircraft weight and size, wingspan, wind and weather conditions, atmospheric turbulence, flight mode, altitude, G-forces, and airspeed. The vortex characteristics of any given aircraft can also be changed by extension of flaps or other wing-configuring devices. Aircraft weight and airspeed tend to form the most influential factors, with slow and heavy aircraft generating stronger vortices. Smaller fighter aircraft, like the F-16, tend to produce minimal vortices that dissipate rapidly (DAF 2011).

Vortices commonly descend behind an aircraft to an altitude of about twice the aircraft's wingspan. For an F-16, that distance would measure about 85 feet. Studies by the DAF (DAF 2006) demonstrate that vortices generated by large aircraft such as B-1Bs and B-52s flying at 500 feet AGL descend and dissipate rapidly and pose no threats to persons, objects, or structures on the ground. Given these results for larger, heavier aircraft, it would be unlikely that the smaller fighter aircraft using the proposed MOAs would generate vortices of sufficient strength or duration to reach the ground and pose a safety risk to other users of the airspace.

Appendix I (Airspace Obstruction Analysis) consists of an obstruction analysis of the proposed airspace reconfigurations. Two obstacles are 500 feet AGL or greater under the Outlaw MOA and two obstacles are 100 feet AGL or greater in the Tombstone MOA. There are no obstructions exceeding the proposed 500 feet AGL floor in the Bagdad or Gladden MOAs.

Nothing within the obstruction analysis would create an adverse impact to safety under the Proposed Action. Vertical obstructions would be noted and avoided as they currently are in existing areas where obstructions intrude into MOAs. Existing restricted areas and public airfields would also be noted and standard outlined safety protocols for avoidance and separation of aircraft for safety would be observed, in accordance with FAA procedures.

Bird/Wildlife Aircraft Strike Hazard

Under the Proposed Action, aircrews would operate in the same general airspace environments of Arizona and New Mexico as they do currently. Lowering the floor of some MOAs in the region would not mean more low-altitude training would occur overall, but rather this training could be accomplished in other locations throughout the region. As such, the overall potential for BASH would not be anticipated to be statistically different with implementation of any of the alternatives and no additional impacts are anticipated. Aircrews operating in the MOAs would be required to follow applicable procedures outlined in each unit's applicable BASH Plan. Adherence to this program has minimized bird strikes. When safety procedures identify an increased risk, limits are placed on low-altitude flights and some types of training (e.g., multiple approaches, closed pattern work). In addition, the historical (worldwide) BASH data indicate that there are fewer incidents during air-to-air operations like those that would occur in the MOAs as compared to incidents during takeoffs and landings at an airfield. Therefore, there would be limited potential for additional mishaps from BASH given the altitudes that would be used and the type of operations in the MOAs. Furthermore, pilots are required to check AHAS prior to all flights and special briefings are provided to pilots whenever the potential exists for greater bird-strike risks within airspace.

Ground Safety

Crash Response

When responding to a crash site, the DAF would consult with the appropriate land use manager to minimize direct damage and coordinate actions. Due to the myriad factors in such an occurrence, detailed steps cannot be foreseen. Each crash response would be considered on a case-by-case basis to minimize the intrusiveness to the maximum extent practicable, consistent with national security considerations and the need to protect life and property from further risk. Secondary effects of an aircraft crash include the potential for fire (discussed below) and environmental contamination (discussed in **Section 3.11**, *Hazardous Materials*). The Proposed Action does not change these procedures and would not increase overall training in the area; therefore, no impact is expected with regards to crash response.

Fire Risk

Flares consist of magnesium and Teflon pellets that burn rapidly and completely after being dispensed. The flares have a greater than 99 percent reliability rate for discharging and burning. A defensive flare is designed to burn out within approximately 200 to 400 feet of deployment (generally within 3–5 seconds). DAF regulations reduce the risk of too-low deployment by restricting training with defensive countermeasures over non-DAF-owned lands (e.g., tribal, federal, private, etc.) to altitudes over 2,000 feet AGL (AFI 11-214). In addition, implementing restrictions on the use of flares based on local fire conditions is a best management practice that is currently implemented for each MOA and is defined in individual unit policies. These restrictions vary depending on the local conditions beneath the MOA and include actions such as raising the minimum release altitude or prohibiting use completely.

On extremely rare occasions, a flare may not ignite and fall to the earth as a dud flare. A dud flare could seriously injure a person if he or she is either struck by the falling dud or if a dud flare is discovered and mishandled. There is no instance of a dud flare or any flare striking an individual on the ground and the probability of such occurring would be extremely rare (DAF 2011). Dud flares could be mishandled if discovered on non-DoD lands; however, since the reliability rate is so high and the geographic distribution of flare usage would be so large the probability of such an occurrence would be low. A dud flare is unlikely to ignite even in a campfire unless it was on a very hot bed of coals. If a dud flare were shot with a bullet or cut with a power saw, the friction could cause it to ignite. There is a minor risk of a fire being caused by a dud flare striking a hard rock surface upon landing, causing a spark and igniting. Across all of the DAF, there is one known and one suspected instance of a dud flare starting a fire in this manner. The potential for a dud flare landing on the surface is very small (calculated as 0.4 percent) and the potential for a dud flare to strike a hard surface at a specific angle is much smaller (DAF 2023b).

A flare fire risk assessment using modeling software was reported in *Environmental Effects of Chaff and Flares* (DAF 1997) and the analysis in this EIS relies on the results of those studies. The probability of a single flare starting a fire cannot be predicted to any level of statistical significance, particularly since it would depend on so many variables as to be totally situationally dependent. If a burning flare reaches the ground or the canopy of a tree or shrub, it may or may not start a fire. The conditions that must be satisfied in order for a fire to start and spread include: (1) the source must be very near to or in contact with a fuel element, (2) the source must have sufficient residual energy to ignite the fuel element, and (3) fuel conditions must support the spread of fire. With regards to fires starting from a flare landing in the crown of a tree or shrub, a burning flare alighting in the crown layer of shrub cover may start a fire, but the crown layer must contain a sufficient density of dead foliage with low enough moisture content to support the spread of fire, or no fire would result. If hot material comes in contact with rotten wood, smoldering combustion can be sustained at temperatures as low as 200 degrees Celsius.

The probability of ignition given a hot inert item reaching the surface can be assessed based on the moisture content of "fuel" (vegetation and other combustible materials on the ground), which can be derived from local meteorological history and current conditions. The National Fire Danger Rating System uses these variables to calculate the fire hazards on a daily basis for the entire country. The system uses a selection of wildland fuel types that together can be used to characterize most forest and rangeland vegetation cover found in the continental U.S. The National Fire Danger Rating System is used primarily for pre-suppression planning over large geographic areas. The system's indices are sensitive to the phenology of vegetation communities; historical precipitation, temperature, and humidity; and current temperature, humidity, and windspeed. The DAF airspace managers use these daily ratings to determine if flares can be safely released in a specific MOA or if a constraint should be implemented. This way a balance can be struck between the risk of igniting a fire, possible consequences of an unwanted fire, and disruption of training operations.

In a fire risk assessment for all DAF ranges and areas where flares are used (DAF 1997), operating parameters (such as release altitude, area, environmental conditions) were too diverse to isolate level of use as the only or primary factor affecting frequency of fires. For this reason, and because flare-caused fires were rare in any case, no statistical correlations can be made between utilization (that is, total number of flares released) and fire occurrence. Thus, the increased number of flares proposed does not directly correlate to an increased fire risk.

3.3.3.3 Alternative 3

Under Alternative 3, all flight activities would continue to be conducted in accordance with applicable regulations, Technical Orders, and Air Force Occupational Safety and Health standards described in **Section 3.3.2**, *Affected Environment*. The obstruction analysis of the proposed airspace in **Appendix I** depicts nine obstacles which are 100 feet AGL or greater under the Jackal MOA (in addition to the two obstacles under the Tombstone MOA discussed in Alternative 2). This excludes two obstacles under the existing Jackal Low MOA. Nothing within the obstruction analysis would create an adverse impact to safety under this alternative. Vertical obstructions would be noted and avoided as they currently are in existing areas where obstructions intrude into MOAs. There would be no aspects of the Proposed Action that would be expected to create new or unique flight safety issues or create additional risk in any of the MOAs. The flight and ground safety concerns would be the same as those described for Alternative 2 – Proposed Action.

3.3.3.4 Alternative 4

Under Alternative 4, all flight activities would continue to be conducted in accordance with applicable regulations, Technical Orders, and Air Force Occupational Safety and Health standards described in **Section 3.3.2**, *Affected Environment*. There would be no aspects of the Proposed Action that would be expected to create new or unique flight safety issues or create additional risk in any of the MOAs. The flight and ground safety concerns would be the same as those described for Alternative 2 – Proposed Action.

3.3.4 Cumulative Impacts

Training activities to be conducted in the optimized MOAs would not be expected to create any ground safety issues. The proposed operations would be similar in nature to the existing operations, would not constitute a novel or increased fire risk, and crash response procedures would remain the same. Likewise, other ongoing or planned military training included in **Appendix G** in the area would adhere to safety regulations, reducing the potential for increased safety risks. However, continued increases in military training activity in the region could slightly increase the number of accidents overall.

There is a proposal for a renewable energy transmission project right-of-way that stretches from Torrance County, New Mexico through Pinal County, Arizona known as the SunZia Southwest Transmission Project. The proposed transmission line would occur in the area between the Tombstone MOA and the Outlaw/Jackal MOAs the purpose of which would be to bring renewable energy to Arizona from existing wind farms located in New Mexico. The ultimate construction and operation of the transmission line itself would not contribute cumulatively since it would be located between the MOAs and would not be at an altitude that would penetrate the airspace. The purpose of the line is to transfer wind energy from New Mexico to Arizona, thus the construction of additional wind farms in Arizona are not expected from construction of this transmission line. Any proposed structure over 200 feet AGL, such as a wind farm, must be reviewed by the FAA to ensure safety of the NAS. The primary means by which the FAA analyzes proposed construction or alteration ("protecting individuals and property on the ground") that may affect navigable airspace is through the Obstruction Evaluation/Airport Airspace Analysis process. A structure proponent must file FAA Form 7460-1, *Notice of Proposed Construction or Alteration*, for any proposed construction or alteration that meets notification criteria described in Federal Aviation Regulation Part 77.13. It is expected that this review process would ensure there would not be a cumulative impact to safety within the proposed MOAs.

3.3.5 Mitigations

There are no significant impacts with regards to safety, thus, no mitigations are required. See **Section 3.2.5**, *Airspace Management and Use, Mitigations*, for any specific mitigations developed during FAA's aeronautical review process which includes a safety risk analysis and public review period as defined in FAA Order JO 7400.2P, *Procedures for Handling Airspace Matters*.

3.4 NOISE

3.4.1 Resource Definition and Regulatory Framework

Noise is considered unwanted sound that interferes with normal activities or otherwise diminishes the quality of the environment. Noise may be intermittent or continuous, steady or impulsive. It may also be stationary or transient. Stationary sources are normally related to specific land uses, e.g., housing tracts or industrial plants. Transient noise sources move through the environment, either along relatively established paths (e.g., highways, railroads, and aircraft flight tracks around airports), or randomly. There is a wide range of responses to noise. Responses vary according to the type of noise and the characteristics of the sound source, the sensitivity and expectations of the receptor, the time of day, and the distance between the noise source (e.g., an aircraft) and the receptor (e.g., a person or animal). Although aircraft are not the only source of noise in any area, they are readily identifiable to those affected by noise they produce.

The physical characteristics of noise include its intensity, frequency, and duration. Sound is created by acoustic energy, which produces pressure waves that travel through a medium, like air, and are sensed by the eardrum. This can be likened to the ripples in water that are produced when a stone is dropped into it. As the acoustic energy increases, the intensity or amplitude of these pressure waves increase, and the ear senses louder noise. The unit used to measure the intensity of sound is the decibel (dB). Sound intensity varies widely (from a soft whisper to a jet engine) and is measured on a logarithmic scale to accommodate this wide range. A 10 dB increase in noise is generally perceived as a doubling of noise. Human hearing ranges from 0 dB (barely audible) to 120 dB, where physical discomfort is caused by the sound.

The Noise Study developed in support of this EIS is provided in **Appendix J**. Detailed technical information concerning the noise modeling software, operational data inputs, and the modeling results are provided in the Noise Study and summarized in the following sections.

3.4.1.1 Noise Metrics

Noise analysis in DoD NEPA documents relies on noise modeling instead of noise measurements. There are multiple reasons for this. In NEPA, the Proposed Action has not yet happened; therefore, real time measurement of new aircraft noise in an area is not possible. There are also many variables that make noise measurements unreliable and difficult to collect, and over such large areas as MOAs, it would be virtually impossible to deploy enough sensors to collect representative data. In November 2021, the Department of the Navy submitted a report to Congress comparing noise modeling to actual measurement of aircraft noise in a controlled study and concluded that modeling is an accurate means of analyzing aircraft noise. The report summarizes the findings of the sound monitoring study, provides an explanation of the analysis, reports the results of real-time sound monitoring, and compares the results to modeled noise contours (Navy 2021).

Many different types of noise metrics, or standards of measurement, have been developed by researchers to represent the effects of environmental noise. The accepted metrics supporting the assessment of noise from military aircraft operations are the Day-Night Average Sound Level (DNL), Onset-Rate Adjusted Day-Night Average Sound Level (L_{dnmr}), C-weighted Day-Night Average Sound Level (CDNL), Maximum Sound Level (L_{max}), and Sound Exposure Level (SEL). The intensity of sonic booms is described in terms of overpressure. The Percentile Level (L_x), where x equals the percentage of time, is used by the NPS for reporting sound levels throughout the U.S. Each is briefly discussed below.

DNL and L_{dnmr}

The DNL is an A-weighted cumulative noise metric that measures noise based on annual average daily aircraft operations. A-weighting reflects frequencies detectable by human hearing. DNL is the U.S. Government standard for modeling the cumulative noise exposure and assessing community noise impacts. DNL uses two time periods: daytime (acoustic day) and nighttime (acoustic night). Daytime hours are from 7 a.m. to 10 p.m., and nighttime hours are from 10 p.m. to 7 a.m. local time. DNL weights operations occurring during its nighttime period by adding 10 dB to their single event sound level.

When DNL is adjusted for the onset rate of the noise to account for the “surprise factor,” the metric is L_{dnmr}. The onset rate adjustment was included in the model calculations; however, in some cases it was small enough to not make a difference in the DNL calculation. Noise model results in this EIS are reported in DNL and L_{dnmr}.

The DoD uses L_{dnmr} as the standard metric for assessing aircraft noise in training airspace. The FAA standard for assessing aircraft noise is DNL. Because this EIS has been developed to meet the NEPA requirements of both agencies, both of these were calculated and are presented in the results.

CDNL

CDNL is used to measure the effects of sonic booms that occur from aircraft flying at supersonic speeds. CDNL is similar to DNL, in that it is a cumulative metric that averages all of the sound energy produced in 1 year. CDNL is based on C-weighted noise, which emphasizes lower frequency sound vibrations. C-weighting better targets the lower frequencies that are “felt,” instead of “heard” – usually impulsive noise caused by things like explosions. CDNL weights nighttime events as described for DNL above.

L_{max} and SEL

A common metric used to describe a single aircraft noise event is the maximum sound level, or L_{max}, measured in dB. L_{max} is the highest A-weighted sound level that occurs during the aircraft overflight. L_{max} describes the maximum level of a noise event but does not take into account its duration. The SEL, measured in dB, is a composite metric that represents both the magnitude and duration of an aircraft overflight. The SEL is a measure of the total acoustic energy in the event, but does not directly represent the sound level heard at any given time.

Overpressure

The intensity of individual sonic booms depends on several factors including aircraft size, shape, weight, altitude, and the maneuver being conducted at the time of the boom (e.g., climbing, diving, turning). The intensity of the boom is measured as an overpressure reported in pounds per square foot (psf). This is not an indicator of how loud a sonic boom is, but rather the overpressure is the pressure above normal atmospheric pressure created by the shock wave generated by a sonic boom measured in psf.

L50

The L50 metric is the statistical “middle point” where sound pressure levels are exceeded 50 percent of the time. In other words, there is a 50 percent chance at any given second, that the sounds experienced would be greater than the value reported. The NPS has used this metric to develop a model for ambient sound throughout the entire U.S. This metric is not a cumulative metric and cannot be directly compared to DNL, but is useful in helping describe rural or quiet places, such as National Parks or Wilderness Areas.

3.4.1.2 Noise Induced Hearing Loss

Noise induced hearing loss risk has been extensively studied, with the consensus that populations exposed to noise greater than 80 dB DNL are at the greatest risk of potential hearing loss (Defense Noise Working Group [DNWG] 2013a). Because no person or place beneath any of the training airspace associated with this EIS would be exposed to noise levels greater than 80 dB DNL, noise induced hearing loss is not discussed further in this analysis.

3.4.1.3 Subsonic and Supersonic Noise

For this EIS, two types of aircraft noise are assessed: subsonic noise and supersonic noise. Conventional subsonic noise is noise generated by an aircraft's engines and airframe. This is the most familiar form of aircraft noise.

When an aircraft flies at supersonic speeds (faster than the speed of sound), shock waves are generated resulting in a sonic boom. The shock wave forms a "cone" of pressurized air molecules which move outward and rearward in all directions from the aircraft. As the "cone" moves outward and away from the aircraft, it gets wider and its strength is reduced. The altitude at which the shock wave is created determines the distance shock waves travel before reaching the ground and affects the intensity of the boom. The higher the aircraft, the greater the distance the shock wave must travel before reaching receptors on the ground, reducing the intensity of the boom. In general, the width of the cone beneath the aircraft is about 1 mile for each 1,000 feet in altitude.

The shape and sound of the sonic boom resulting from supersonic flight depends on the aircraft's size, weight, geometry, flight altitude, speed, and type of maneuvering. Aircraft exceeding the speed of sound always create a sonic boom; however, not all supersonic flight activities will cause a boom audible at the ground. As altitude increases, air temperature decreases, and these layers of temperature change can cause booms to be reflected, or turned upward, and in some cases the boom never reaches the ground.

A sonic boom is characterized as an overpressure which is a rapid rise in pressure, followed by a rapid drop-off before the pressure returns to normal atmospheric levels. This change occurs very quickly (significantly less than 1 second). In the vast majority of cases, the overpressures created are well below levels that would cause physical injury or damage to structures. In rare cases, a sonic boom could cause physical damage, as to a window, if the overpressure is of sufficient magnitude. Sonic booms may also cause startle effects in humans and animals.

3.4.2 Affected Environment

Federal, state, and local governments regulate noise to prevent noise sources from affecting noise sensitive areas, such as residences, hospitals, and schools, and to protect human health and welfare. Federal agencies, such as the Department of Housing and Urban Development, have established health-based maximum noise exposure recommendations. Local agencies, including cities and counties, are responsible for defining and enforcing land use compatibility in various noise environments.

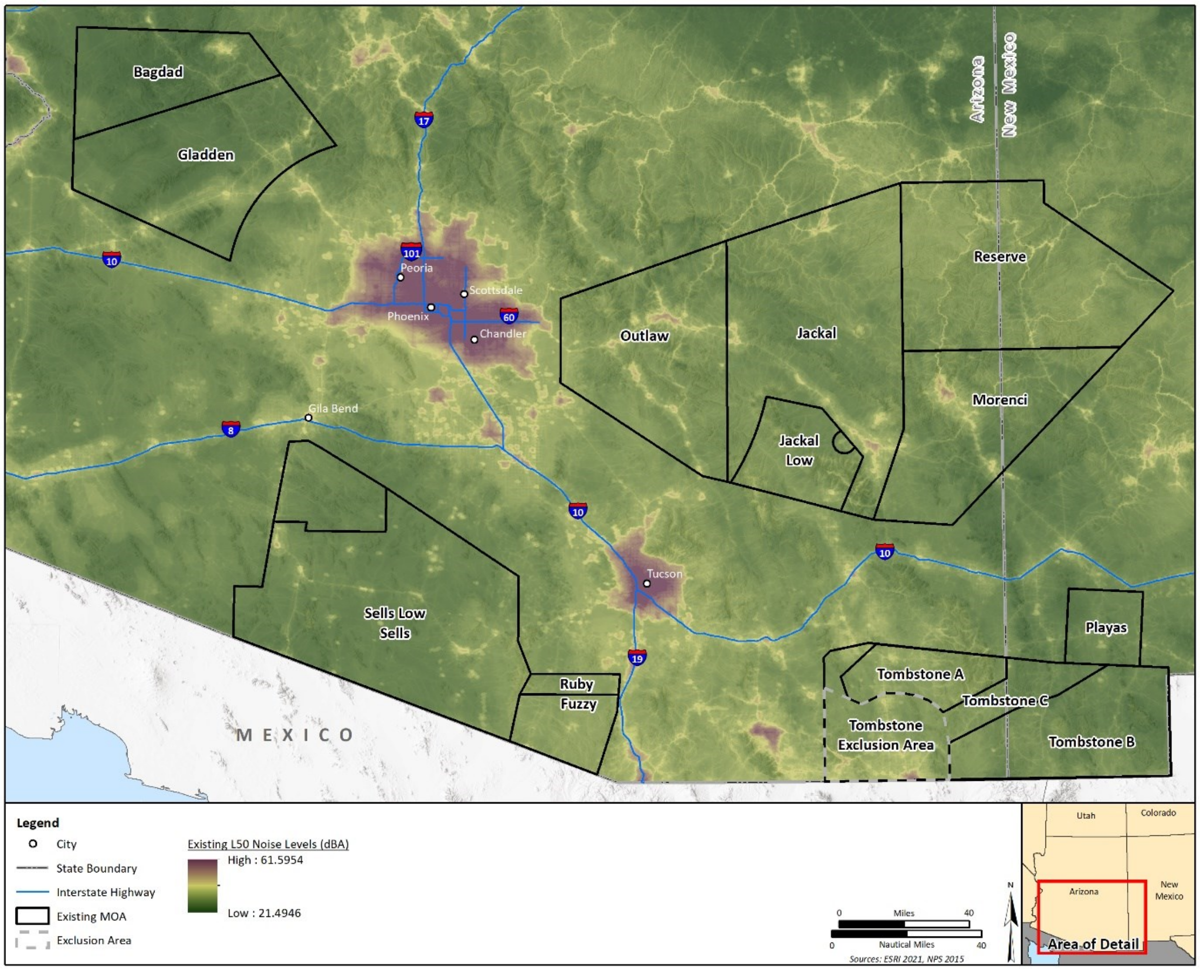
Generally, the airspace described in Chapter 2.0 is existing, and is currently used by military aircraft. While many of these areas would be considered rural and generally quiet, there are times of use by military aircraft where aircraft-generated noise would be noticeable and potentially considered annoying, depending on the time and location of the observer.

Many of the areas that underlie the existing and proposed airspace described in Chapter 2 are undeveloped wilderness or rural areas. Because of the remote nature of these areas and their large size, ambient noise levels are difficult to predict, but are assumed to be quite low since these areas lack man-made noise sources (traffic, industrial activities, etc.). The NPS Sound Map program has produced predictive sound maps for the U.S. and their park units to help determine the quality of the acoustic environment. These maps use the noise metric L50 dBA, which is the A-weighted sound level which exceeds the reported sound value 50 percent of the time being measured. In other words, there is a 50 percent chance at any given second, that the sounds experienced would be greater than the value reported. The L50 dBA existing sound pressure levels within the MOAs associated with the Proposed Action are shown in **Table 3.4-1**, which gives maximum and minimum values within each of the MOA units. The L50 dBA metric is not directly comparable to the FAA and DAF standards of DNL and L_{dnmr}; however, this metric does provide a frame of reference for the quietness of the existing ambient noise conditions beneath the MOAs and throughout the general region. L50 is nearly unaffected by single (or multiple discreet) events that are particularly loud, such as sonic booms or low-altitude jet overflights, which is one reason why the metric is not often used by DAF or other Federal agencies such as FAA. **Figure 3.4-1** shows the sound map results of the L50 dBA modeling from the NPS in the vicinity of the MOAs. Note that the Sound Map uses sampled noise values for human activity based on things like roads, airports, and population density, and does not necessarily capture aircraft noise in airspace for either military or civil air traffic.

Table 3.4-1 Existing Sound Map Noise Levels within MOAs

MOA	Existing L50 dBA	
	Max	Min
Tombstone A	38	28
Tombstone B	37	26
Tombstone C	49	26
Tombstone (Exclusion Area)	49	29
Jackal	44	28
Jackal Low	41	28
Outlaw	45	28
Morenci	45	26
Reserve	40	28
Gladden/Bagdad	40	24
Sells	42	27
Fuzzy	40	31
Ruby	40	30

Legend: dBA = A-weighted decibel; Max = Maximum; Min = Minimum; MOA = Military Operations Area.
Source: NPS 2015.



Legend: dBA = A-weighted decibel; MOA = Military Operations Area.

Figure 3.4-1 Ambient Sound Pressure Levels in L50 dBA in Vicinity of MOAs

3.4.3 Environmental Consequences

Noise analysis requires data defining aircraft activity in terms of time in the MOA/ATCAA airspace, as well as the speed, altitude, power setting, and position information. This analysis quantifies the anticipated subsonic and supersonic noise from military aircraft activity within the existing and proposed airspace.

The U.S. Environmental Protection Agency (USEPA) has identified 55 dB DNL as a level that protects public health and welfare with an adequate margin of safety (USEPA 1982). This means that 55 dB DNL is a threshold below which adverse noise effects are not expected to occur. According to the Federal Interagency Committee on Urban Noise (FICUN), noise exposure greater than 65 dB DNL is considered generally incompatible with residential, public use (i.e., schools), or recreational and entertainment areas (FICUN 1980). The U.S. Army Public Health Command indicates that 62 C-weighted decibels (dBC) CDNL is the level at which one could expect a rise in annoyance similar to that of a DNL level of 65 dB for subsonic noise (U.S. Army Center for Health Promotion and Preventive Medicine 2005).

The FAA defines a threshold for significant noise impacts as an increase in noise by 1.5 dB DNL or more in a noise sensitive area that is exposed to noise at or above the 65 dB DNL noise exposure level, or that will be exposed at or above the 65 dB DNL level due to a 1.5 dB or greater increase, when compared to the No Action Alternative for the same timeframe (FAA Order 1050.1F).

For airspace actions, FAA requires that an action proponent identify where noise will change by the following specified amounts in noise sensitive areas (FAA Order 1050.1F):

- For DNL 65 dB and higher: +/- DNL 1.5 dB (significant)
- For DNL 60 dB to <65 dB: +/- DNL 3 dB (reportable)
- For DNL 45 dB to <60 dB: +/- DNL 5 dB (reportable)

Per FAA Order 1050.1F, a noise sensitive area is defined as an area where noise interferes with normal activities associated with its use. Normally, noise sensitive areas include residential, educational, health, and religious structures and sites, and parks, recreational areas, areas with wilderness characteristics, wildlife and waterfowl refuges, and cultural and historical sites. The FAA recognizes that there are settings where the 65 dB DNL standard for land use compatibility may not apply. These areas would likely be areas of extreme quiet, very rural areas, or natural areas with little human activity, such as wilderness areas or other protected natural areas.

The primary effect of recurring aircraft noise on exposed communities is long-term annoyance. The scientific community has adopted the use of long-term annoyance as a primary indicator of community response because it attempts to account for all negative aspects of effects from noise, including sleep disturbance, speech interference, and distraction from other human activities. Attitudinal surveys conducted over the past 30 years show a consistent relationship between DNL and the percentages of people who express annoyance. The Committee on Hearing, Bioacoustics, and Biomechanics (1981) developed the equivalent relationship between annoyance and CDNL from sonic booms. The relationship of annoyance to DNL and CDNL is presented in **Table 3.4-2**. While not a determination of significance, the calculated DNL and CDNL for the MOAs addressed in this EIS can be compared against **Table 3.4-2** to provide an estimate of the percentage of the population that would be "highly annoyed" by the noise.

Table 3.4-2 Relationship of Annoyance to DNL and CDNL

DNL (dBA)	Percent Highly Annoyed	CDNL (dBC)
45	0.83	42
50	1.66	46
55	3.31	51
60	6.48	56
65	12.29	60
70	22.10	65

Legend: CDNL = C-weighted Day-Night Average Sound Level; dBA = A-weighted decibel; dBC = C-weighted decibel; DNL = Day-Night Average Sound Level.
Sources: DNWG 2009; Committee on Hearing, Bioacoustics, and Biomechanics 1981; Finegold et al. 1994.

There is generally public concern that aircraft noise has non-auditory health effects, which are physiological effects on health and well-being (i.e., stress response and cardiovascular effects) that are caused by exposure to aircraft noise. While there is a substantial amount of research on the topic, most of the studies concern chronic exposure to high levels of noise, like that experienced in an airport environment with hundreds of flights per day. The DNWG stated that the current state of scientific knowledge cannot yet support inference of a causal or consistent relationship between military aircraft noise exposure and non-auditory health consequences for exposed residents. The results of published studies of aircraft noise on human health are unclear. There is no scientific basis for concluding that aircraft noise has a negative non-auditory health impact (DNWG 2013b).

More recently, the Department of the Navy developed a detailed literature review on the non-auditory health effects of aircraft noise in support of the *Naval Air Station Whidbey Island Complex Growler EIS* (Department of the Navy 2018) and developed similar conclusions based on more recent research than the DNWG (2013b) used for its conclusions. This literature review included many recent papers on topics ranging from hypertension and heart disease, stroke, and mental health. Numerous research studies seem to indicate that aircraft noise may contribute to the risk of health disorders, along with other factors such as heredity, medical history, smoking, alcohol use, diet, exercise, and air pollution, but that the measured effect is small compared to these other factors and often not statistically significant (Department of the Navy 2018). The literature review also noted that the European Network on Noise and Health concluded that, "while the literature on non-auditory health effects of environmental noise is extensive, the scientific evidence of the relationship between noise and non-auditory health effects is still contradictory," in its summary report of 2013 (European Network on Noise and Health 2013). As a result, it is not possible to state that there is sound scientific evidence that aircraft noise is a significant contributor to health disorders (Department of the Navy 2018).

3.4.3.1 Single Event Noise Calculations

Low-Level Overflight Calculations

While the DoD and FAA standards for noise analysis are cumulative noise metrics (DNL and L_{dnmr}), the noise analysis in support of this EIS also developed modeled estimates for single event metrics, which describe the noise an observer would experience during an actual aircraft overflight. These metrics are not significance indicators but rather provide supplemental information to the public, stakeholders, and decision-makers. A number of scenarios were modeled for the various aircraft types that would be typically operating within the MOAs described under the Proposed Action. These scenarios are representative of the events that currently occur and could occur from lowering the MOA floors in several MOAs and are applicable to all alternatives analyzed in this EIS.

Two metrics were calculated to describe the loudness of a single overflight event: L_{max} and the SEL for a single event (see **Section 3.4.1.1** for definitions). Calculating these metrics requires consideration of a variety of aircraft power settings, airspeeds, and flight altitudes. Power settings can employ full power (known as military or "mil" thrust) or use of engine afterburner, the loudest power setting. Use of the afterburner in training is limited because of the high fuel consumption and is generally only used at higher altitudes.

Another factor that drastically affects the loudness of an overflight is the distance between the aircraft and the observer. As the distance between an overflight and the observer increases, the noise level decreases. To illustrate this effect, relevant scenarios were developed to quantify the noise levels at various lateral offsets from the overflight:

- *Scenario 1:* Overflight at the lowest possible altitude (100 feet AGL). This altitude is currently only available in the Jackal Low and Fuzzy MOAs but would be available in the Tombstone MOA (Alternatives 2, 3, and 4) and Jackal MOA (Alternative 3).
- *Scenario 2:* Overflight at 500 feet AGL. This lower altitude would be available in more MOAs in the region to include the Bagdad, Gladden, Outlaw, and Jackal MOAs.
- *Scenario 3:* Overflight at 10,000 feet AGL, above which most of training time is spent. This represents the most common single event exposure.

The L_{max} and SEL calculations for these scenarios are provided in **Tables 3.4-3 through 3.4-5**. These tables show that overflight sound levels rapidly drop off when the overflight is not directly overhead. A lateral offset of 1,000 or 5,000 feet reduces the noise considerably.

An F-16 direct overflight with afterburner at 100 feet AGL would have an L_{max} as high as 131 dB (**Table 3.4-3**). The L_{max} (which is the peak noise level) occurs for about 1/8 of a second. An F-16 overflight at 500 feet AGL would have a peak noise level of 120 dB. Peak noise levels (L_{max}) at these altitudes are similar for F-35 (**Table 3.4-4**), but considerably less for the A-10 that has an L_{max} of 113 dB at 100 feet AGL and 102 dB at 500 feet AGL (**Table 3.4-5**). It should be noted that F-16 and F-35 overflights at 100 feet AGL would be extremely rare, as discussed below. To provide a frame of reference, the average noise level for some common noise sources include: firecrackers (140 dB), a rock band concert (120 dB), a lawnmower (95 dB), a vacuum cleaner 10 feet away (85 dB), and a garbage disposal (75 dB).

Even in areas of the MOAs where no special flight restrictions apply, experiencing noise from an aircraft that is directly overhead at the lowest possible altitude would be relatively rare. The following factors limit the frequency of exposure to low-altitude overflights within any MOA:

- Aircrew would avoid congested areas, such as a city, town, or settlement, or open-air assembly of people, by a minimum of 1,000 feet above the highest obstacle within a radius of 2,000 feet in accordance with 14 CFR 91.119.
- Aircrew would avoid overflight of persons, vehicles, or structures while flying in uncongested areas by 500 feet in accordance with 14 CFR 91.119.
- Flight at low altitudes requires an extreme level of vigilance on the part of the aircrew, and time spent at the lowest available altitudes would be only as needed to accomplish low-altitude training requirements.

Table 3.4-3 L_{max} and SEL Values (in dB) for F-16C Overflights at Different Power Settings, Altitudes and Lateral Offsets[1]

Offset (feet lateral distance)	Scenario 1: Aircraft Altitude – 100 feet AGL				Scenario 2: Aircraft Altitude – 500 feet AGL				Scenario 3: Aircraft Altitude – 10,000 feet AGL			
	L_{max}		SEL		L_{max}		SEL		L_{max}		SEL	
	MIL	A/B	MIL	A/B	MIL	A/B	MIL	A/B	MIL	A/B	MIL	A/B
0	124–128	127–131	126–130	129–133	113–116	116–120	116–119	119–122	82–85	86–90	85–88	89–93
1,000	106–109	109–113	109–112	112–116	106–109	109–113	109–112	112–116	82–85	86–90	85–88	89–93
5,000	85–88	88–91	88–91	91–94	90–93	93–97	93–96	96–100	80–83	85–88	83–86	88–91

Note: [1]A range of values is provided for each metric since the F-16 variants flown by DAF in Arizona have two different engine types. The speed used for these models was 450 knots.

Legend: A/B = Afterburner Thrust; AGL = Above Ground Level; DAF = Department of the Air Force; L_{max}=maximum sound level; MIL = Military-rated thrust; SEL=Sound Exposure Level.

Table 3.4-4 L_{max} and SEL Values (in dB) for F-35A Overflights at Different Power Settings, Altitudes and Lateral Offsets[1]

Offset (feet lateral distance)	Scenario 1: Aircraft Altitude – 100 feet AGL				Scenario 2: Aircraft Altitude – 500 feet AGL				Scenario 3: Aircraft Altitude – 10,000 feet AGL			
	L_{max}		SEL		L_{max}		SEL		L_{max}		SEL	
	MIL	A/B	MIL	A/B	MIL	A/B	MIL	A/B	MIL	A/B	MIL	A/B
0	129	131	121	134	117	121	120	124	87	92	90	95
1,000	110	114	114	118	110	115	113	118	87	92	90	95
5,000	89	94	92	97	94	99	97	102	85	91	88	94

Note: [1]The speed used for these models was 450 knots.

Legend: A/B = Afterburner Thrust; AGL = Above Ground Level; L_{max}=maximum sound level; MIL = Military-rated thrust; SEL=Sound Exposure Level.

Table 3.4-5 L_{max} and SEL Values (in dB) for A-10 Overflights at Different Altitudes and Lateral Offsets[1]

Offset (feet lateral distance)	Scenario 1: Aircraft Altitude – 100 feet AGL		Scenario 2: Aircraft Altitude – 500 feet AGL		Scenario 3: Aircraft Altitude – 10,000 feet AGL	
	L_{max}	SEL	L_{max}	SEL	L_{max}	SEL
	MIL	MIL	MIL	MIL	MIL	MIL
0	113	115	102	104	72	75
1,000	96	99	96	99	72	75
5,000	77	80	81	84	70	73

Note: [1]The speed used for these models was 300 knots.

Legend: AGL = Above Ground Level; L_{max}=maximum sound level; MIL = Military-rated thrust; SEL=Sound Exposure Level.

- The MOAs in the region are very large, ranging from a minimum of 376,000 acres to over 3 million acres, and any particular location on the ground would be overflown at low altitudes relatively infrequently. Training within MOAs occurs randomly throughout the horizontal extent of the MOAs.

Table 3.4-6 contains estimates of the likelihood of direct overflight by military aircraft at low altitudes (100 feet and 500 feet), to put a numerical reference to terms used throughout this EIS such as "rare" or "infrequent." These values were calculated by assuming that an aircraft within 45 degrees of directly overhead would be perceived as "overhead" by an observer. The number of sorties by individual aircraft, and the time spent at lower altitude along with their speed, was used to calculate the total area covered by these low altitude flights (see **Appendix J,** *Noise Study*, for a detailed breakdown of sorties by altitude band, by aircraft, by MOA). Over the course of 1 week, it was then determined how likely a particular location would be included in that area. For example, an F-16 traveling 400 knots for one minute at 300 feet AGL would "cover," within 45 degrees, a swath of land of about 558 acres (or 0.87 square mile). The likelihood of any particular area experiencing that overflight event would be the ratio of that area to the area of the MOA. When extrapolated for the total sorties in the week, and the durations and speeds are included, the result is an estimate for any single location being directly overflown by a military aircraft that week at low altitude.

Table 3.4-6 Percent Chance of Direct Low-Level Overflight per Week[1,2]

MOA	Alternative 1 – No Action		Alternative 2		Alternative 3		Alternative 4	
	100 feet	500 feet	100 feet	500 feet	100 feet	500 feet	100 feet	500 feet
Tombstone	0	2%	<1%	7%	0	4%	<1%	7%
Outlaw	0	0	0	1%	0	1%	0	1%
Jackal	0	0	0	<1%	<1%	5%	0	<1%
Jackal Low[3]	1%	23%	1%	28%	--	--	1%	28%
Morenci	0	0	0	0	0	0	0	0
Reserve	0	0	0	0	0	0	0	0
Gladden/ Bagdad	0	0	0	3%	0	3%	0	3%
Sells	0	0	0	0	0	0	0	0
Fuzzy	<1%	12%	<1%	14%	<1%	14%	<1%	14%

Notes: [1]"Overflight" considers aircraft within 45 degrees of true vertical.
[2]Percent Chance is the total area covered by low-altitude aircraft operations divided by the area of the MOA.
[3] Under Alternative 3, the Jackal MOA would have a floor of 100 feet absorbing the current Jackal Low MOA.
Legend: % = percent; < = less than; MOA = Military Operations Area.

As shown, the potential to experience an overflight at 100 feet, which corresponds to the highest single event noise levels for an overflight, is either nil or very low in all MOAs for all alternatives (no more than 1 percent). This is due to very few events in the training syllabus requiring performance at such a very low altitude. In the areas without existing or proposed lower floors, Morenci, Reserve, and Sells MOAs, the chances of experiencing the higher noise levels would be nil in all alternatives. In areas proposed for lower floors (Tombstone, Gladden/Bagdad, Jackal, and Outlaw MOAs), the chances would still be very low (on the order of 1 to 7 percent for a given week).

The area of the Jackal Low MOA is small, so the likelihood of experiencing a low-level flight is the highest. For a given week under Alternative 1 – No Action, there is about 1 percent chance of an overflight at 100 feet AGL. For those overflights at 500 feet, that chance rises to about 23 percent which amounts to an average of one overflight per month, or about 12 times per year on average. Under

Alternative 3, the Jackal MOA would be lowered to 100 feet AGL, which would absorb the current Jackal Low MOA. Thus, the percent chance of experiencing an overflight at 500 feet reduces since the area of the MOA would be expanded.

Sonic Boom Calculations

The intensity of individual sonic booms depends on several factors including aircraft size, shape, weight, altitude, and the maneuver being conducted at the time of the boom (e.g., climbing, diving, turning). **Table 3.4-7** shows calculated overpressures in psf for F-16 and F-35 aircraft at various speeds and altitudes. The psf is not an indicator of how loud a sonic boom is, but rather the pressure above normal atmospheric pressure created by the shock wave generated by a sonic boom. This change in pressure occurs very quickly (i.e., in significantly less than 1 second). The values in **Table 3.4-7** assume steady, level flight at these speeds. These scenarios are representative of the sonic boom events that could potentially occur now and those that could occur from supersonic flight operations at lower altitudes in several MOAs depending on the alternative as detailed in **Table 3.4-8**.

Table 3.4-7 Sonic Boom Overpressures for Relevant Fighter Aircraft (pounds per square foot)

Aircraft Type[2]	Altitude and Speed[1]					
	5,000 feet AGL		10,000 feet AGL		30,000 feet AGL	
	Mach 1.2	Mach 1.4	Mach 1.2	Mach 1.4	Mach 1.2	Mach 1.4
F-16C	7.5	8.3	4.2	4.7	1.5	1.6
F-35A	8.4	9.4	4.9	5.3	1.7	1.8

Note: [1] These calculations do not account for topography. Thus the altitudes are presented generically in AGL.
[2]A-10s do not fly supersonic, thus overpressures were not calculated.
Legend: AGL = above ground level.

Table 3.4-8 Comparison of Supersonic Authorizations in all MOAs for all Alternatives

MOA/ATCAA	Alternative 1–No Action Existing Minimum Altitude	Alternatives 2 and 3–Proposed Minimum Altitude	Alternative 4–Proposed Minimum Altitude
Tombstone	FL300	5,000 feet AGL	10,000 feet AGL
Outlaw	FL300	5,000 feet AGL	10,000 feet AGL
Jackal	FL300	5,000 feet AGL	10,000 feet AGL
Morenci	FL300	5,000 feet AGL	10,000 feet AGL
Reserve	FL300	5,000 feet AGL	10,000 feet AGL
Bagdad	10,000 feet MSL	No change	No change
Gladden	10,000 feet MSL	No change	No change
Sells	10,000 feet MSL	No change	No change
Ruby	Not authorized	No change	No change
Fuzzy	Not authorized	No change	No change

Legend: AGL = above ground level; ATCAA = Air Traffic Control Assigned Airspace; MOA = Military Operations Area; MSL = mean sea level.

Experiencing supersonic noise or the maximum psf from an aircraft that is directly overhead at the lowest possible altitude is relatively rare for the reasons and factors described above in **Section 3.4.3.1**, *Low-Level Overflight Calculations*.

Sonic boom intensity varies upward or downward from the values in **Table 3.4-7** for aircraft executing maneuvers while flying at supersonic speeds. Plotkin (1990) noted that aircraft maneuvers may create "focus booms" with overpressures 2 to 5 times the magnitude of steady state sonic booms. Due to the many variables involved in the training in the existing and proposed MOAs/ATCAAs, it is impossible to predict when and where sonic booms or focus booms may occur. Focus booms are a rare phenomenon. They occur when a jet turns during supersonic flight. Such maneuvers are usually avoided because of the stresses placed on the aircraft. Additionally, this amplified overpressure impacts only a very small area when compared to the area exposed to the rest of the sonic boom.

Tests by the Air Force on sonic booms have found that most structures in good condition are not affected by sonic booms with a peak overpressure of less than 16 psf. Tests by the National Aeronautics and Space Administration have shown that structures in good condition are undamaged by overpressures of up to 11 psf. Damage to plaster is in a comparable range of glass but depends on the condition of the plaster. Adobe faces risks similar to plaster, but assessment is complicated by adobe structures being exposed to weather, where they can deteriorate in the absence of any specific loads. At 1 psf, the probability of a window breaking ranges from one in a billion (Plotkin and Sutherland 1990) to one in a million (Hershey and Higgins 1976) with the probability depending on boom magnitude, boom angle of incidence, and the condition of the window. In general, structural damage from sonic booms should be expected only for overpressures over 10 psf (Plotkin and Sutherland 1990)**.**

3.4.3.2 Alternative 1 – No Action

This section details the modeled subsonic and supersonic noise exposure from aircraft-generated noise within the existing MOAs.

Subsonic Noise Exposure

Table 3.4-9 shows the number of sorties, including the breakdown of acoustic night sorties that were modeled for Alternative 1 – No Action.

Table 3.4-9 Total Sorties and Nighttime Sorties – Alternative 1 – No Action

MOA/ATCAA	Total Sorties	Nighttime Sorties[1]		Acoustical Night Sorties[2]	
		Percent	Number	Percent	Number
Tombstone	3,450	11	380	2	74
Jackal/Outlaw	5,190	11	571	1	50
Morenci/Reserve	3,350	10	335	1	27
Gladden/Bagdad	6,920	12	830	0	32
Sells	14,790	15	2,219	2	275
Ruby/Fuzzy	5,490	10	549	1	51

Notes: [1]Nighttime sorties are those flights that occur after sunset.
[2]Acoustical night is defined as 10:00 p.m. to 7:00 a.m.
Legend: ATCAA = Air Traffic Control Assigned Airspace; MOA = Military Operations Area.

Table 3.4-10 shows the L_{dnmr} and DNL levels for Alternative 1 – No Action within the existing MOAs. The noise levels computed in **Table 3.4-10** represent only the military aircraft contributions to sound levels and do not consider other sources. The greatest L_{dnmr} value under the No Action is 58.6 dB in the Fuzzy MOA and the least L_{dnmr} value is in the Tombstone C MOA calculated at <35 dB.

Table 3.4-10 Noise Levels Attributable to Military Aircraft Operations – Alternative 1 – No Action

MOA	DNL (dB)	L_{dnmr} (dB)
Tombstone A	56.0	56.0
Tombstone B	53.3	53.3
Tombstone C	<35	<35
Jackal	37.3	37.3
Jackal Low	48.6	49.7
Outlaw	37.8	37.8
Morenci	42.4	42.4
Reserve	38.6	38.6
Gladden/Bagdad	50.5	50.5
Sells	48.5	48.5
Fuzzy	57.8	58.6
Ruby	44.7	44.7

Legend: dB = decibel; DNL = Day-Night Average Sound Level; L_{dnmr} = Onset Rate Adjusted Day-Night Average Sound Level; MOA = Military Operations Area.

The DoD noise modeling software does not calculate values below 35 dB due to difficulty of accurately predicting very low noise levels. Because of this, noise levels attributed to aircraft that range from zero to 34 dB are reported as "< 35 dB." At 35 dB, noise would often be imperceptible because it would be masked by common outdoor natural sounds (such as breeze rustling foliage, birds, insects, rain), or man-made sounds (such as vehicles traveling on roads in the vicinity). In rural areas, especially those without foliage that are far from roads, the natural quiet state can be lower than 35 dB. Such quiet could be experienced by a back-country hiker far from roads on a calm day. An aircraft noise in the range of 20 to 30 dB may be perceptible in those circumstances. Note that a small number of single events over the course of a year could all be individually noticeable or loud, but that the cumulative metric (DNL or L_{dnmr}) could still be very low (such as <35 dB).

Table 3.4-10 shows that in most of the locations, the L_{dnmr} and DNL values are the same. The locations where they are not the same are where lower altitude flying occurs (Fuzzy and Jackal Low MOAs), because the adjustment for rise time (surprise of the observer) is more pronounced when fast aircraft are operated at lower altitudes. As shown, the noise environment within the MOAs under the Alternative 1 – No Action is relatively low with none of the areas exceeding 65 dB DNL.

__Supersonic Noise Exposure__

Table 3.4-11 shows the number of supersonic sorties that would occur under Alternative 1 – No Action. This table also shows the authorized altitudes for supersonic operations within the different MOAs/ATCAAs.

Table 3.4-11 Annual Supersonic Sorties – Alternative 1 – No Action

MOA/ATCAA	Supersonic Sorties[1]		Existing Minimum Authorized Altitude
	Percent	Number	
Tombstone	0	0	FL300
Jackal/Outlaw	12	623	FL300
Morenci/Reserve	11	369	FL300
Gladden/Bagdad	65	4,498	10,000 feet MSL
Sells	60	8,874	10,000 feet MSL
Ruby/Fuzzy	0	0	Not Authorized

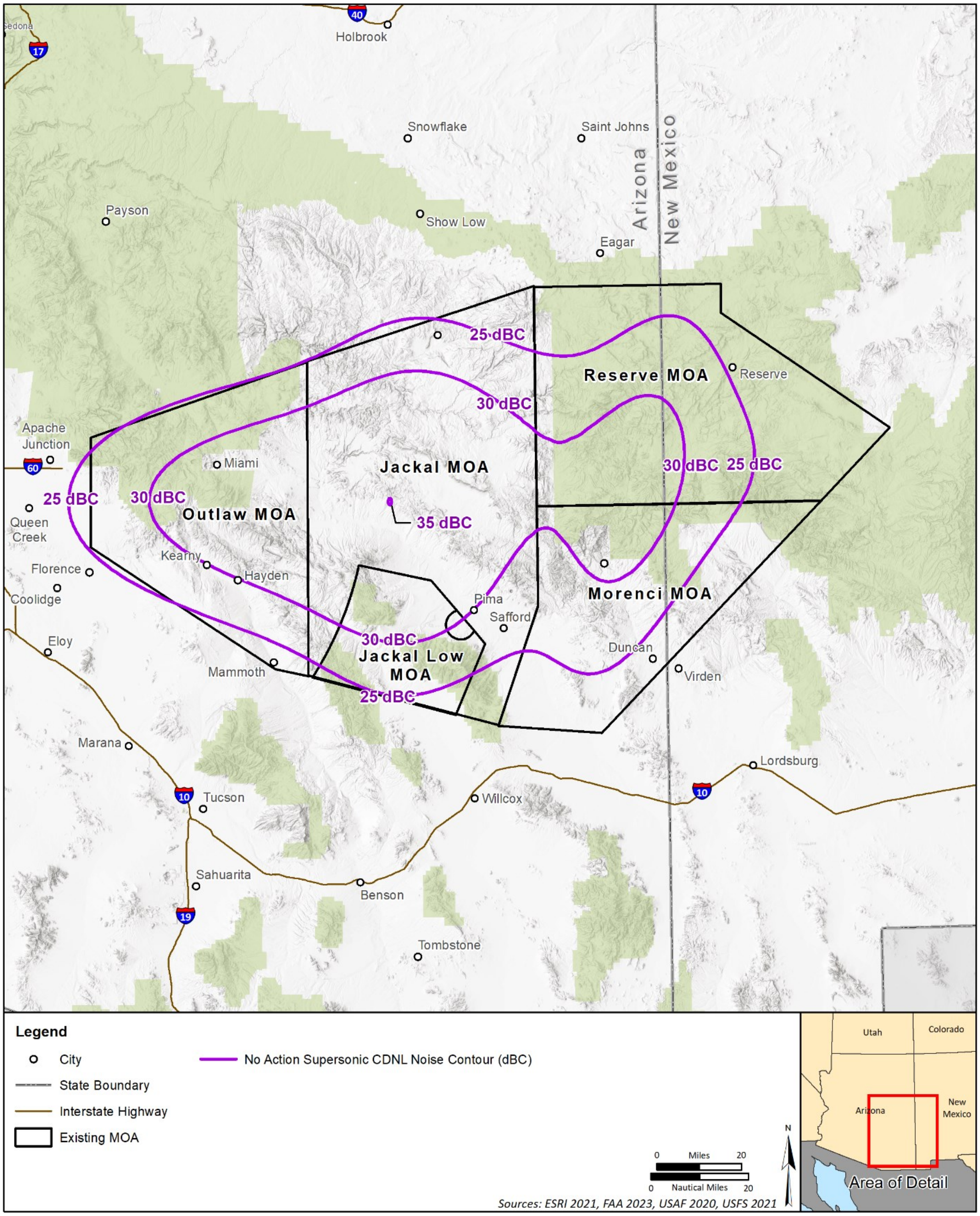
Note: [1]Supersonic speed does not occur for the duration of the sortie, but rather during one or more 30–60 second increments.

Legend: ATCAA=Air Traffic Control Assigned Airspace; MOA=Military Operations Area; MSL = Mean Sea Level.

The standard measure of the noise levels produced by supersonic flight is CDNL, the average of all the sound energy produced by supersonic activity. Production of sonic booms depends on many variables, and use of the CDNL metric helps to average them all out over time. Sonic booms beneath or adjacent to the MOAs/ATCAAs would have varying intensity (see **Section 3.4.3.2** for a description of single event sonic booms). For the supersonic analysis, some MOAs/ATCAAs are grouped together (i.e., Jackal, Outlaw, Morenci, Reserve) since this is how they are used for supersonic training. **Figures 3.4-2 through 3.4-4** show the calculated CDNL contours attributed to annual supersonic activity for each MOA/ATCAA or complex of MOAs/ATCAAs under the No Action Alternative. The center contour shows the area with the highest CDNL value along with two additional contour bands in 5-dB increments. As described in *Subsonic Noise Exposure* above, the noise modeling software does not generally calculate values below 35 dBC due to difficulty of accurately predicting very low noise levels. CDNL values less than 35 dBC are typically not shown on figures for this reason; however, they are shown on **Figure 3.4-2**, Outlaw, Jackal, Morenci, and Reserve MOAs for consistency with the other figures that show the highest CDNL center contour followed by two additional contour bands.

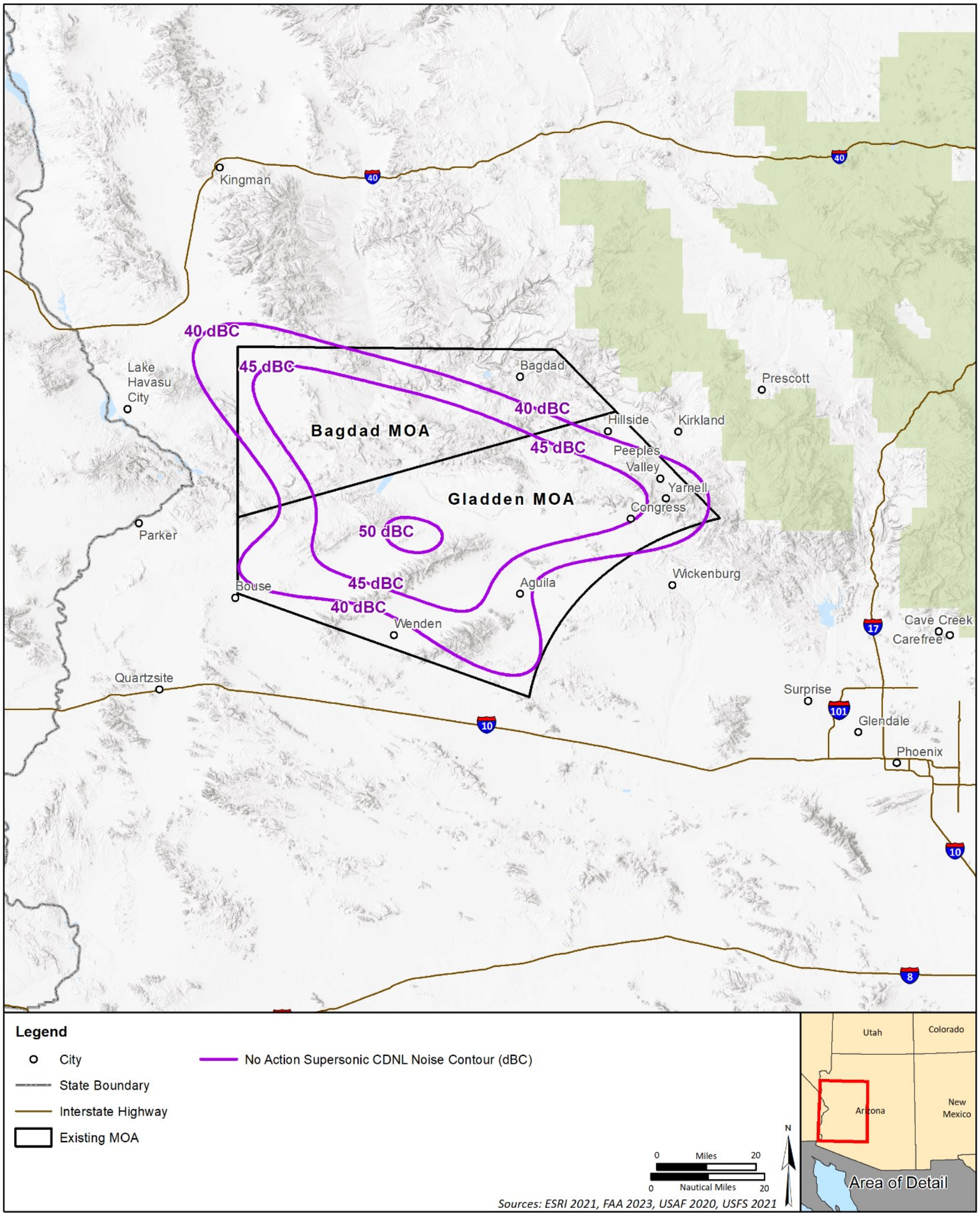
It should be noted that the software program used to calculate subsonic noise (MRNMap) assumes an almost even distribution of operations throughout the airspace; therefore, there are only small differences in the DNL values near the MOA boundary and contour figures are not meaningful. The model used for supersonic noise (BooMap) concentrates operations towards the center of the airspace based on typical supersonic flight characteristics, thus, there are defined CDNL noise contours to illustrate on a figure.

Table 3.4-12 shows the maximum CDNL from military aircraft supersonic operations within each MOA/ATCAA or complex of MOAs/ATCAAs under the No Action Alternative. The CDNL values for all the MOAs/ATCAAs are low. Tombstone ATCAA is authorized for supersonic operations above FL300, but currently no operations include supersonic flight. Thus, the calculated CDNL is shown as "n/a" and no figure is presented.



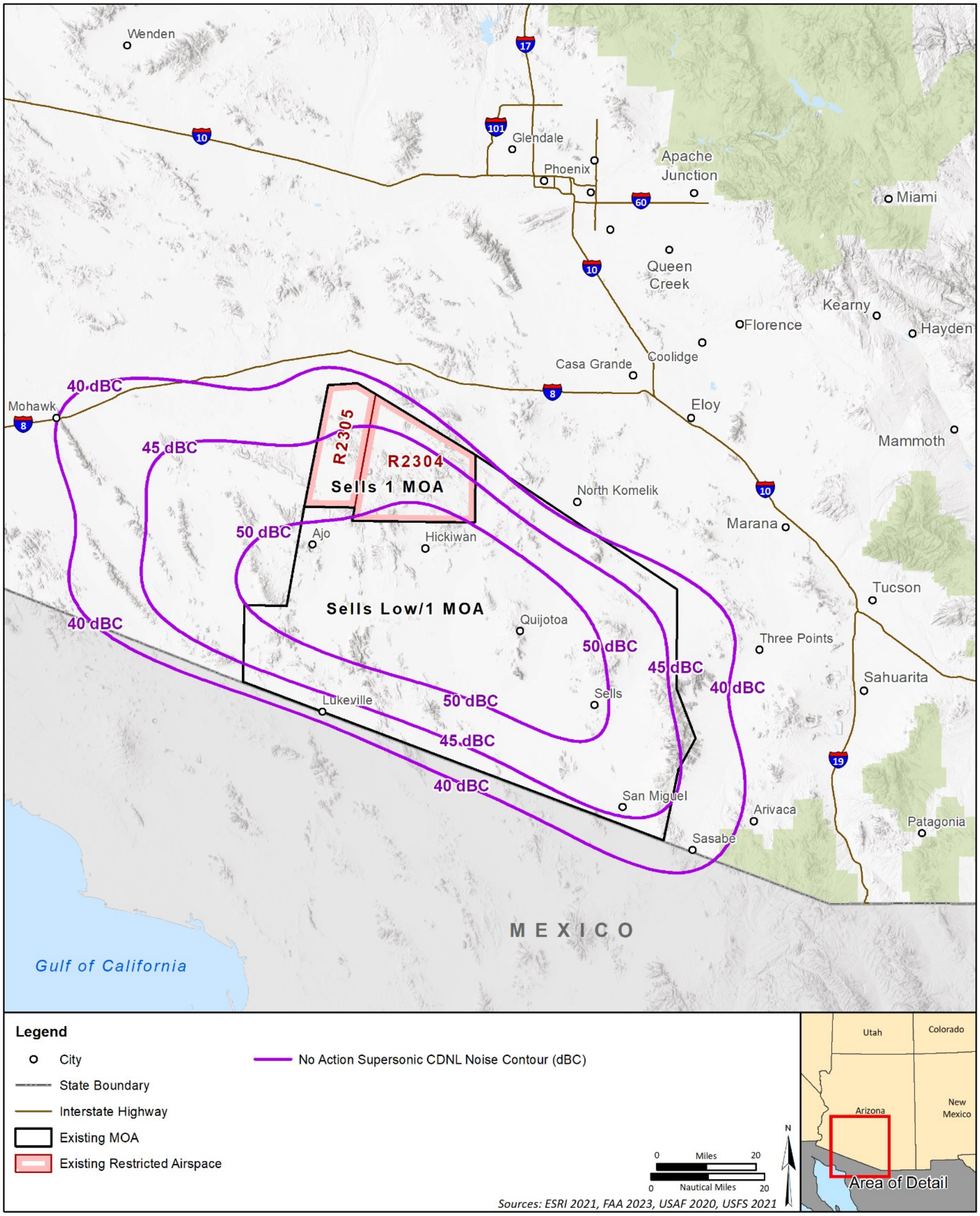
Legend: CDNL = C-weighted Day-Night Average Sound Level; dBC = C-weighted decibel; MOA = Military Operations Area.

Figure 3.4-2 CDNL Contours for Outlaw/Jackal/Morenci/Reservice MOAs – Alternative 1 – No Action



Legend: CDNL = C-weighted Day-Night Average Sound Level; dBC = C-weighted decibel; MOA = Military Operations Area.

Figure 3.4-3 CDNL Contours for Bagdad/Gladden MOAs – Alternative 1 – No Action



Legend: CDNL = C-weighted Day-Night Average Sound Level; dBC = C-weighted decibel; MOA = Military Operations Area.

Figure 3.4-4 CDNL Contours for Sells MOA – Alternative 1 – No Action

Table 3.4-12 Supersonic Noise from Military Aircraft – Alternative 1 – No Action

MOA/ATCAA	Maximum CDNL (dBC)
Tombstone	n/a
Jackal/Outlaw/Morenci/Reserve	35
Gladden/Bagdad	50
Sells	55

Legend: ATCAA = Air Traffic Control Assigned Airspace; CDNL = C-weighted Day-Night Average Sound Level; dBC = C-weighted decibel; MOA = Military Operations Area.
Source: Stantec 2023.

In all MOAs/ATCAAs, the No Action Alternative is below the level expected to result in annoyance. The U.S. Army Public Health Command indicates that 62 dBC CDNL is the level at which one could expect a rise in annoyance similar to that of a DNL level of 65 dB for subsonic noise (U.S. Army Center for Health Promotion and Preventive Medicine 2005).

In the Outlaw/Jackal/Morenci/Reserve MOAs/ATCAAs, the No Action Alternative results in a very small area that would be exposed to 35 dBC CDNL (see **Figure 3.4-2**). Additional contours are depicting 30 and 25 dBC CDNL, which are very low levels not normally reported. Single sonic boom events would individually produce higher levels, but the average level represented by the CDNL metric is very low.

In the Gladden and Bagdad MOAs/ATCAAs, the highest CDNL is 50 dBC (see **Figure 3.4-3**). Additional contours are shown for 45 and 40 dBC.

Figure 3.4-4 shows the CDNL contours for the No Action Alternative in the Sells MOA/ATCAA. It also shows the highest contour as CDNL 50 dBC, with additional contours illustrated for 45 and 40 dBC. The contour beneath Sells MOA/ATCAA is larger than that beneath other MOAs due to the larger number of annual sorties that occur here. Note that the contours extend outside Sells MOA/ATCAA to the west. This is because the Sells MOA/ATCAA is often used in conjunction with the Restricted Area R-2301E, which is located to the west, but is not part of the Proposed Action.

Tombstone, Outlaw, Jackal, Morenci, and Reserve all have a FL300 minimum altitude for supersonic operations. The maximum possible psf for a direct overflight for an F-16C aircraft flying straight and level at 30,000 feet ranges from 1.5 to 1.6 psf depending on the aircraft speed (see **Table 3.4-7**). The F-35A results in slightly higher overpressure values at this altitude ranging from 1.7 to 1.8 psf depending on the speed. Within Bagdad, Gladden, and Sells MOAs the minimum altitude for supersonic flight is 10,000 feet MSL resulting in higher psf values for single overflights: 4.2 to 4.7 for an F-16C and 4.9 to 5.3 for an F-35 depending on the aircraft speed. As described in **Section 3.4.3.2**, *Sonic Boom Calculations*, structural damage from sonic booms at these levels is unlikely**.** See **Section 3.10.3**, *Cultural Resources, Environmental Consequences*, for additional information concerning structural damage.

3.4.3.3 Alternative 2 – Proposed Action

This section details the noise exposure from military aircraft-generated noise for the fully optimized MOAs, as well as providing a comparison to Alternative 1 – No Action.

Subsonic Noise Exposure

Table 3.4-13 shows the number of sorties, including the breakdown of acoustic night sorties that were modeled for Alternative 2 – Proposed Action.

Table 3.4-13 Total Sorties and Nighttime Sorties – Alternative 2

MOA/ATCAA	Total Sorties	Nighttime Sorties[1]		Acoustical Night Sorties[2]	
		Percent	Number	Percent	Number
Tombstone	8,000	11	880	2	171
Outlaw/Jackal	6,610	11	727	1	63
Morenci/Reserve	4,050	10	405	1	32
Gladden/Bagdad	9,120	12	1094	0	42
Sells	17,810	15	2672	2	331
Ruby/Fuzzy	7,610	10	761	1	71

Note: [1] Night sorties are those flights that occur after sunset.
[2] Acoustical night is defined as 10:00 p.m. to 7:00 a.m. Percentages in this table have been rounded up to the nearest whole number.
Legend: ATCAA = Air Traffic Control Assigned Airspace; MOA = Military Operations Area.

As shown in **Table 3.4-14**, when compared to Alternative 1 – No Action, Alternative 2 would result in changes to the DNL and L_{dnmr} in all of the MOAs, although the majority would have a very minor change. Noise levels computed in this table represent only the military aircraft contributions to sound levels and do not consider other sources, such as road traffic and wind. The areas with the largest change would be Jackal, Jackal Low, Outlaw, and Gladden/Bagdad MOAs, and parts of the Tombstone MOA. These are the MOAs that have the greatest adjustment to altitudes of flight training, thus an increase in noise exposure would be expected. FAA Order 1050.1F defines as significant a 1.5 dB increase for a noise sensitive area that is exposed to noise at or above the 65 dB DNL 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. None of the MOAs would have an increase defined as significant per FAA Order 1050.1F. The resulting noise exposure would not exceed 65 dB DNL in any MOA, indicating the noise is generally compatible with all land uses.

FAA Order 1050.1F requires that special consideration must be given to the evaluation of noise impacts in areas of quiet setting where compatible land use criteria are not relevant to the value, significance, and enjoyment of the area (e.g., wilderness areas, national wildlife refuge, etc.). A "reportable impact" is defined as a change in noise level of DNL 3 dB or more for DNL 60 dB to less than DNL 65 dB and a change in noise level of DNL 5 dB or more for DNL 45 dB to less than DNL 60 dB. Thus, a "reportable" noise impact in noise sensitive areas would occur in Jackal MOA, Jackal Low MOA, Bagdad MOA, Gladden MOA, and parts of the Tombstone MOA given the noise increases exceed 5 dB.

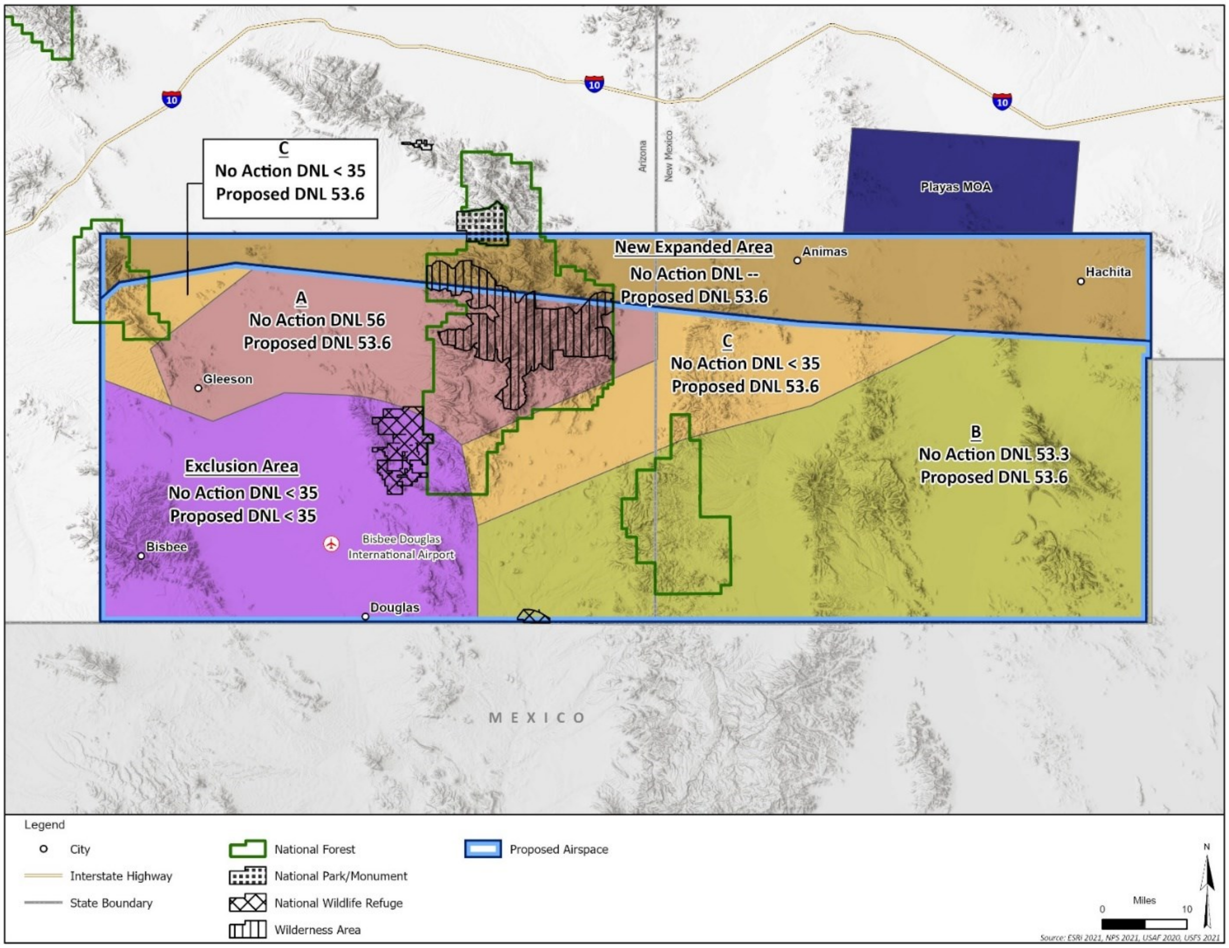
Table 3.4-14 Noise Levels Attributable to Military Aircraft Operations – Alternative 2

MOA	Alternative 1 – No Action		Alternative 2 – Proposed Action		Change		FAA Determination of Impact in Noise Sensitive Areas
	DNL (dB)	L_{dnmr} (dB)	DNL (dB)	L_{dnmr} (dB)	DNL (dB)	L_{dnmr} (dB)	
Tombstone A	56.0	56.0	53.6	55.1	-2.4	-0.9	Not significant
Tombstone B	53.3	53.3	53.6	55.1	0.3	1.8	Not significant
Tombstone C [1]	<35	<35	53.6	55.1	18 (approximate)	20 (approximate)	Reportable
Tombstone (Proposed Expansion) [2]	--	--	53.6	55.1	--	--	Reportable
Tombstone (Exclusion Area)	<35	<35	<35	<35	0	0	Not significant
Jackal	37.3	37.3	47.3	47.7	10	10	Reportable
Jackal Low	48.6	49.7	55.8	59.1	7	9	Reportable
Outlaw	37.8	37.8	42.5	42.5	5	5	Not significant
Morenci	42.4	42.4	43.1	43.1	1	1	Not significant
Reserve	38.6	38.6	39.2	39.2	1	1	Not significant
Gladden/Bagdad	50.5	50.5	57.6	58.0	7	8	Reportable
Sells	48.5	48.5	49.3	49.3	1	1	Not significant
Fuzzy	57.8	58.6	59.6	60.5	2	2	Not significant
Ruby	44.7	44.7	46.4	46.4	2	2	Not significant

Notes: [1]MRNMap software calculates noise from aircraft and does not calculate values below 35 dB due to difficulty of accurately predicting very low noise levels. Because of this, noise levels attributed to aircraft that range from zero to 34 dB are reported as "< 35 dB." Thus, an exact "change" cannot be quantified since the exact DNL is unknown. In this table, the change shown is the difference from 35 dB and is an approximate value.
[2]MRNMap calculates DNL/L_{dnmr} for military aircraft activity. There is currently no military aircraft activity in the proposed expansion area of Tombstone, thus there is no modeled DNL or L_{dnmr} to calculate a "change."

Legend: dB = decibel; DNL = Day-Night Average Sound Level; FAA = Federal Aviation Administration; L_{dnmr} = Onset Rate Adjusted Day-Night Average Sound Level; MOA = Military Operations Area; MSL = Mean Sea Level.

Unlike the other MOAs, Tombstone MOA consists of several blocks of airspace with different floors and the noise results vary within the space. **Figure 3.4-5** provides an illustration of the changes reported in **Table 3.4-14** for the Tombstone MOA. There would be minor changes in noise exposure in the existing Tombstone A and B MOAs. Areas beneath Tombstone C that are outside of Tombstone A and B and the current exclusion area around the Bisbee Douglas Airport (color coded light orange on **Figure 3.4-5**) would experience more noise exposure than they do currently. These areas currently do not experience low-level military overflights, but under the Proposed Action, the MOA floor would be lowered to 100 feet AGL which would generate a noticeable difference in noise exposure. Noise levels attributed to aircraft that range from zero to 34 dB are reported as "< 35 dB" due to DoD noise modeling software limitations for very low noise levels. Therefore, a specific "change" in these parts of Tombstone C cannot be quantified since the exact existing noise level below 35 dB is not known. It can be assumed that the change would be at least an increase of 18 dB DNL or 20 dB L_{dnmr}. The noise impact in sensitive areas beneath parts of the Tombstone C MOA would be considered "reportable" by FAA Order 1050.1F.



Legend: DNL = Day-Night Average Sound Level; MOA = Military Operations Area.

Figure 3.4-5 Subsonic Noise Exposure Changes in Tombstone MOA – Alternative 2

In the proposed Tombstone MOA expansion area, the Alternative 1 – No Action DNL is not calculated since there currently are no military aircraft operating in this area. The model only accounts for military aircraft activity. Therefore, a specific "change" in this area cannot be quantified. It is assumed the current noise environment is relatively low and general noise sources would be from commercial or civil aircraft, road traffic, and other non-human sources such wind and thunder. It is assumed this area would have similar increases in noise exposure as Tombstone C MOA. Conservatively, the change in this area would also be considered a "reportable" noise impact in noise sensitive areas according to FAA Order 1050.1F.

Supersonic Noise Exposure

Table 3.4-15 shows the number of supersonic sorties that would occur under Alternative 2 – Proposed Action. This table also shows the authorized altitudes for supersonic operations within the different MOAs/ATCAAs.

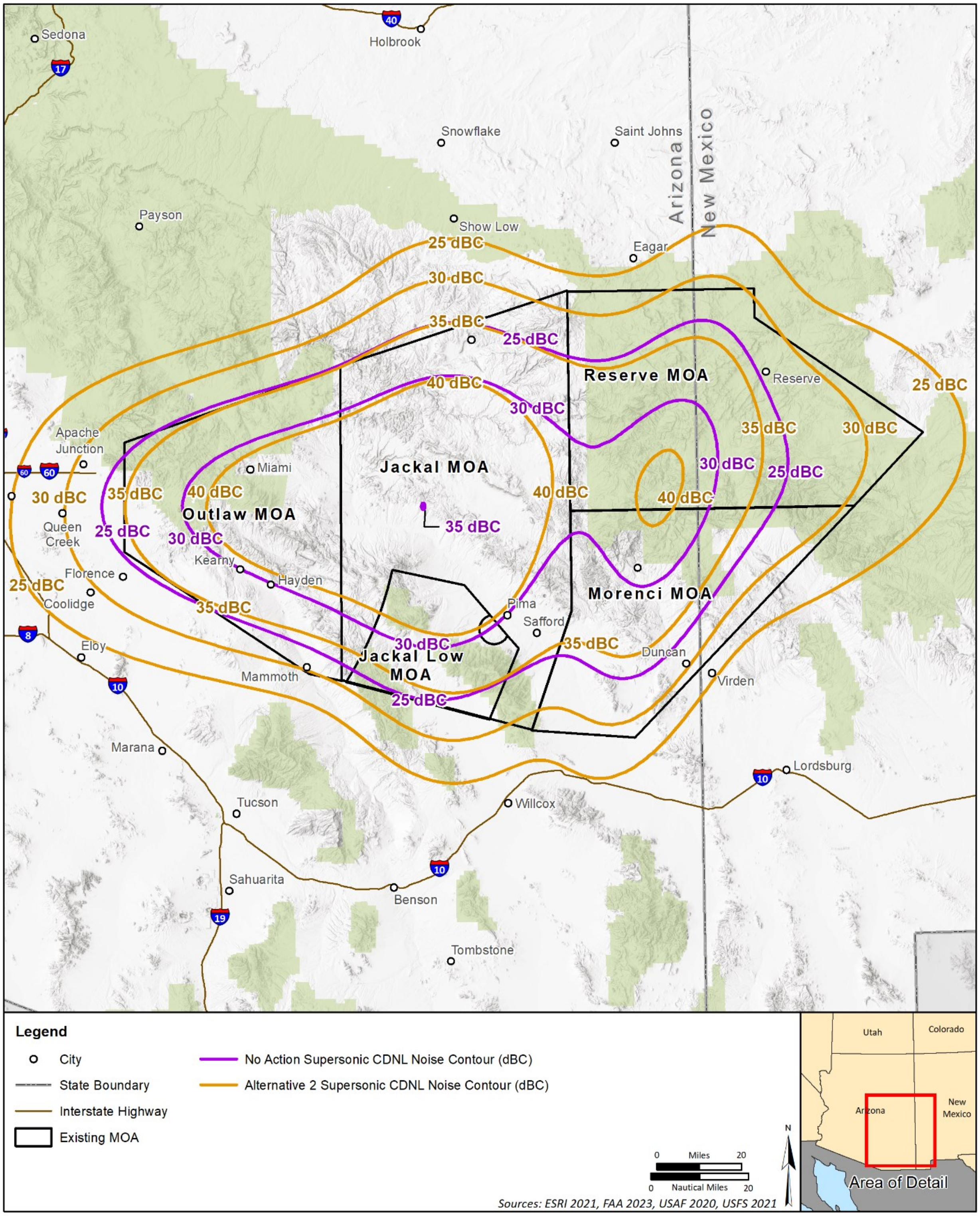
Table 3.4-15 Annual Supersonic Sorties – Alternative 2

MOA/ATCAA	Supersonic Sorties[1]		Minimum Authorized Altitude
	Percent of Total	Number	
Tombstone	1	80	5,000 feet AGL
Jackal/Outlaw	14	925	5,000 feet AGL
Morenci/Reserve	11	446	5,000 feet AGL
Gladden/Bagdad	66	6,019	10,000 feet MSL (existing authorization)
Sells	60	10,686	10,000 feet MSL (existing authorization)
Ruby/Fuzzy	0	0	Not Authorized

Notes: [1]Supersonic speed does not occur for the duration of the sortie, but rather during one or more 30–60 second increments.

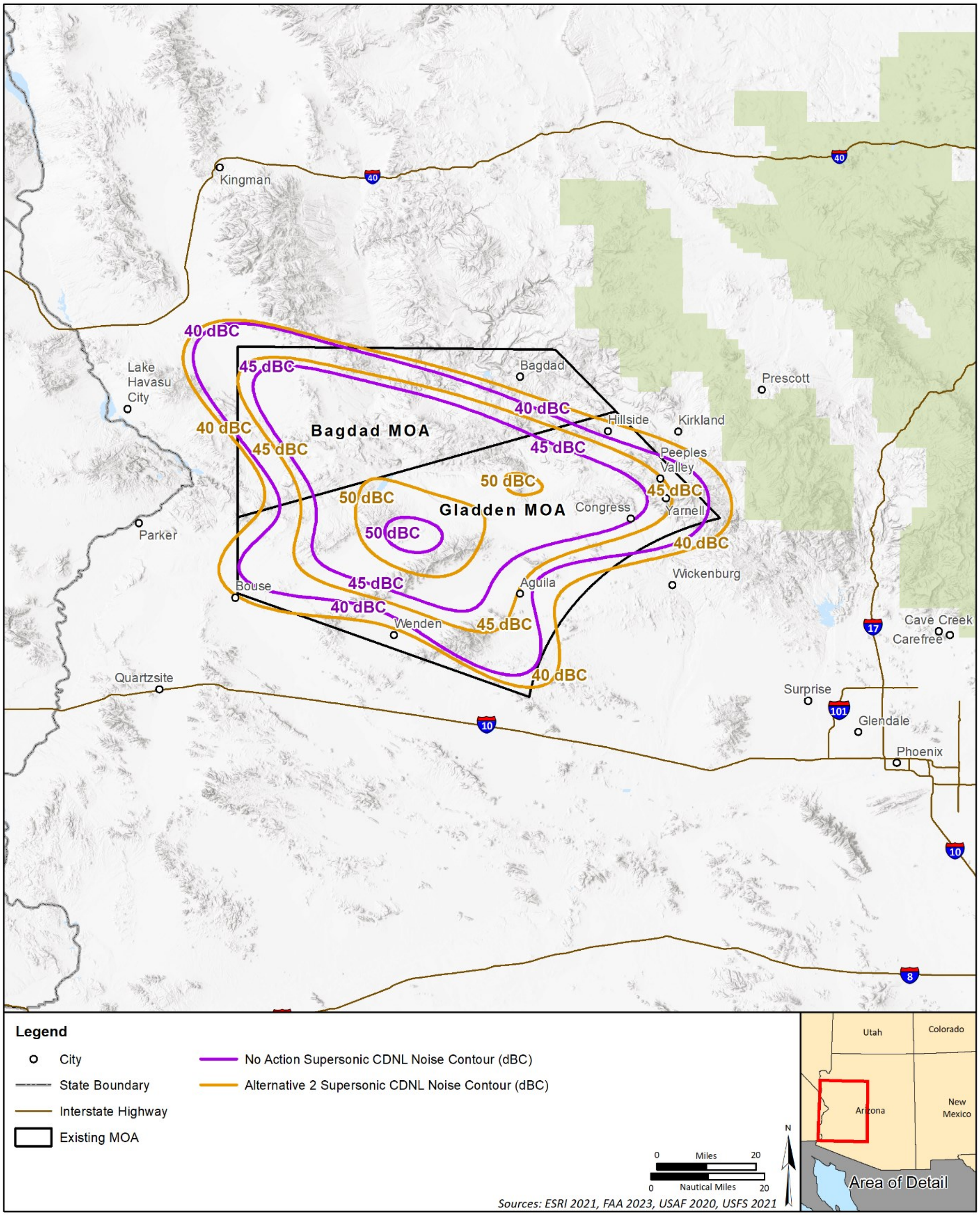
Legend: AGL = above ground level; ATCAA = Air Traffic Control Assigned Airspace; MOA = Military Operations Area; MSL = mean sea level.

Figures 3.4-6 through 3.4-8 show the predicted CDNL contours attributed to annual supersonic activity for Alternative 2 – Proposed Action. The center contour shows the area with the highest CDNL value along with two additional contour bands in 5-dB increments. **Table 3.4-16** shows the maximum CDNL from military aircraft supersonic operations within each MOA under Alternative 2 – Proposed Action and compares this value to No Action. As shown, the CDNL values for all the MOAs are very low, and do not exceed the 62 dBC CDNL standard expected to cause annoyance. A figure for Tombstone MOA was not created since the maximum CDNL is less than 35 dBC, which is considered to be low enough that cumulative metrics are difficult to accurately project. The low CDNL value is due to the very low proposed number of sorties in the Tombstone MOA that might involve supersonic flight, averaging less than two per week. There would be some single event sonic booms that would be noticeable at various locations beneath the MOAs, but the cumulative effect would be very low. For the supersonic analysis, some MOAs are grouped together (i.e., Jackal, Outlaw, Morenci, Reserve MOAs) since this is how they are used for supersonic training. It should be noted that contours for 35 dBC and 25 dBC are shown on the figure for Outlaw, Jackal, Morenci, and Reserve MOAs, however, as stated above, these values are low enough that cumulative metrics are difficult to accurately project.



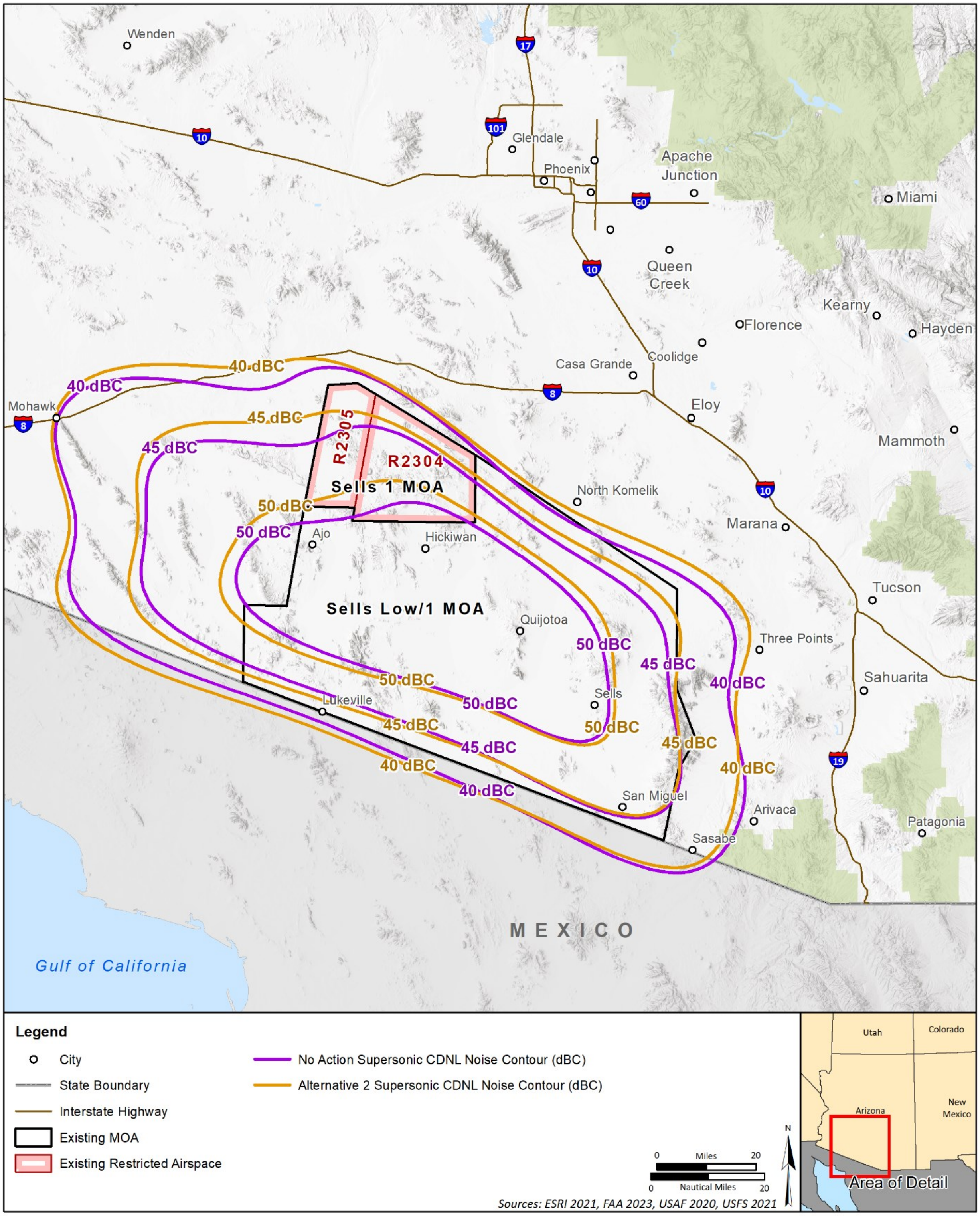
Legend: CDNL = C-weighted Day-Night Average Sound Level; dBC = C-weighted decibel; MOA = Military Operations Area.

Figure 3.4-6 CDNL Contours for Jackal/Outlaw/Morenci/Reserve MOAs – Alternative 2 – Proposed Action



Legend: CDNL = C-weighted Day-Night Average Sound Level; dBC = C-weighted decibel; MOA = Military Operations Area.

Figure 3.4-7 CDNL Contours for Bagdad/Gladden MOAs – Alternative 2 – Proposed Action



Legend: CDNL = C-weighted Day-Night Average Sound Level; dBC = C-weighted decibel; MOA = Military Operations Area.

Figure 3.4-8 CDNL Contours for Sells MOA – Alternative 2 – Proposed Action

Table 3.4-16 Supersonic Noise from Military Aircraft – Alternative 2

MOA/ATCAA	Alternative 1 – No Action Maximum CDNL (dBC)	Alternative 2 – Proposed Action Maximum CDNL (dBC)	Change (dBC)
Tombstone[1]	N/A	<35	N/A
Jackal/Outlaw/Morenci/Reserve	35	44	9
Gladden/Bagdad	50	52	2
Sells[2]	55	55	<1

Note: [1]Tombstone is authorized for supersonic operations under the No Action but currently no supersonic operations occur. The CDNL under Alternative 2 is too low to accurately model, thus a specific change is not calculable.
[2]The CDNL values for Alternative 1 and Alternative 2 in Sells MOA both round to 55, although there is a small difference of less than 1 dBC.

Legend: ATCAA = Air Traffic Control Assigned Airspace; CDNL = C-weighted Day-Night Average Sound Level; dBC = C-weighted decibel; MOA = Military Operations Area; N/A = Not Applicable.

Source: Stantec 2023.

Under Alternative 2 – Proposed Action, the supersonic authorization in Bagdad, Gladden, and Sells MOAs would remain the same and the potential intensity of sonic booms remains unchanged in these MOAs. As described in **Section 2.2.2**, the noise analysis includes a conservative 10 percent increase in all MOAs to allow for flexibility in use year-to-year, so there is the potential for sonic booms to be slightly more frequent in these areas during years that sorties are higher and this is why all of the contour bands expand slightly as compared to the No Action on **Figures 3.4-7 and 3.4-8**.

Under Alternative 2 – Proposed Action, the minimum altitude for supersonic flights within Tombstone, Outlaw, Jackal, Morenci, and Reserve MOAs would be lowered from FL300 to 5,000 feet AGL. Lowering the supersonic authorization allows aircrews to train as they would fight more effectively, allowing them to focus on the training activity without introducing artificial constraints and limits (see **Section 1.3.1** for comparison of real-world scenario versus training in SUA without appropriate attributes). Supersonic flights at lower altitudes would increase the intensity of sonic booms. Operations (subsonic or supersonic) at the lowest possible altitude are rare for a number of reasons as described in **Section 3.4.3.1**. At the proposed minimum altitude (5,000 feet AGL), an F-16C could produce a maximum overpressure as high as 8.3 psf (**Table 3.4-17**). This would represent an increase of 6.7 psf over the No Action Alternative. Similarly, an F-35A at the proposed minimum altitude (5,000 feet AGL) could produce a maximum overpressure of 9.4 psf. This results in an increase of 7.6 psf over the No Action Alternative. Research shows that high intensity sonic booms are rare in military training events (Plotkin 1990). These values represent the maximum impact, but as stated above most operations would be well above 5,000 feet AGL resulting in much lower psf values. See **Section 3.10.3**, *Cultural Resources, Environmental Consequences*, for information concerning structural damage from sonic booms.

Table 3.4-17 Maximum Sonic Boom Overpressures[1] – Alternative 2

MOA	Alternative 1 – No Action		Alternative 2 – Proposed			
	F-16	F-35	F-16	Change from No Action	F-35	Change from No Action
Tombstone	1.6	1.8	8.3	6.7	9.4	7.6
Outlaw/Jackal/Morenci/Reserve	1.6	1.8	8.3	6.7	9.4	7.6

Note: [1]Calculations based on lowest possible altitude with speed of Mach 1.4.

Supersonic flight and any resulting sonic booms are expected to be rare in the Tombstone MOA given the limited size of the MOA and the low number of sorties that include supersonic flight (80 sorties per year). The Outlaw, Jackal, Morenci, and Reserve MOA complex covers a vast geography, overlying 10 counties, and supersonic flight could occur anywhere in this space, but would likely be concentrated towards the center of the MOAs (see **Figure 3.4-6**). Approximately 1,371 sorties per year are expected to include supersonic speed in this complex. Given the size and distribution of these operations, experiencing a supersonic flight at the lowest possible altitude would be rare in any single location and would not be expected to occur with any sort of frequency or regularity.

3.4.3.4 Alternative 3

This section details the noise exposure from aircraft-generated noise for Alternative 3, as well as providing a comparison to Alternative 1 – No Action.

Subsonic Noise Exposure

Table 3.4-18 shows the total sorties, nighttime sorties, and those that occur during acoustical night. For subsonic noise, Alternative 3 is the same as Alternative 2 for all of the MOAs except for the Jackal, Jackal Low, and Tombstone MOAs.

Table 3.4-18 Total Sorties and Nighttime Sorties – Alternative 3

MOA/ATCAA	Total Sorties	Nighttime Sorties[1]		Acoustical Night Sorties[2]	
		Percent	Number	Percent	Number
Tombstone	6,900	11	759	2	148
Outlaw/Jackal	7,710	11	848	1	74
Morenci/Reserve	4,050	10	405	1	32
Gladden/Bagdad	9,120	12	1,094	0	42
Sells	17,810	15	2,672	2	331
Ruby/Fuzzy	7,610	10	761	1	71

Note: [1]Night sorties are those flights that occur after sunset.
[2]Acoustical night is defined as 10:00 p.m. to 7:00 a.m. Percentages in this table have been rounded up to the nearest whole number.
Legend: ATCAA = Air Traffic Control Assigned Airspace; MOA = Military Operations Area.

Table 3.4-19 shows the L_{dnmr} and DNL levels for Alternative 1 – No Action and Alternative 3 within the MOAs. The noise levels computed in **Table 3.4-19** represent only the military aircraft contributions to sound levels and do not consider other sources, such as road traffic and wind.

Table 3.4-19 Noise Levels Attributable to Military Aircraft Operations - Alternative 3

MOA	Alternative 1 – No Action		Alternative 3		Change		FAA Determination of Impact in Noise Sensitive Areas
	DNL (dB)	L_{dnmr} (dB)	DNL (dB)	L_{dnmr} (dB)	DNL (dB)	L_{dnmr} (dB)	
Tombstone A	56.0	56.0	54.7	56.2	-1.3	0.2	Not significant
Tombstone B	53.3	53.3	54.7	56.2	1.4	2.9	Not significant
Tombstone C[1]	<35	<35	54.7	56.2	20 (approximate)	21 (approximate)	Reportable
Tombstone (Exclusion Area)	<35	<35	<35	<35	0	0	Not significant
Jackal	37.3	37.3	49.6	51.9	12	15	Reportable
Jackal Low	48.6	49.7	--	--	--	--	N/A
Outlaw	37.8	37.8	42.5	42.5	5	5	Not significant

MOA	Alternative 1 – No Action		Alternative 3		Change		FAA Determination of Impact in Noise Sensitive Areas
	DNL (dB)	L_{dnmr} (dB)	DNL (dB)	L_{dnmr} (dB)	DNL (dB)	L_{dnmr} (dB)	
Morenci	42.4	42.4	43.1	43.1	1	1	Not significant
Reserve	38.6	38.6	39.2	39.2	1	1	Not significant
Gladden/Bagdad	50.5	50.5	57.6	58.0	7	8	Reportable
Sells	48.5	48.5	49.3	49.3	1	1	Not significant
Fuzzy	57.8	58.6	59.6	60.5	2	2	Not significant
Ruby	44.7	44.7	46.4	46.4	2	2	Not significant

Notes: [1]MRNMap software does not calculate values below 35 dB due to difficulty of accurately predicting very low noise levels. Because of this, noise levels attributed to aircraft that range from zero to 34 dB are reported as "< 35 dB." Thus, a "change" cannot be quantified since the exact DNL is unknown. In this table, the change shown is the difference from 35 dB and is an approximate value.

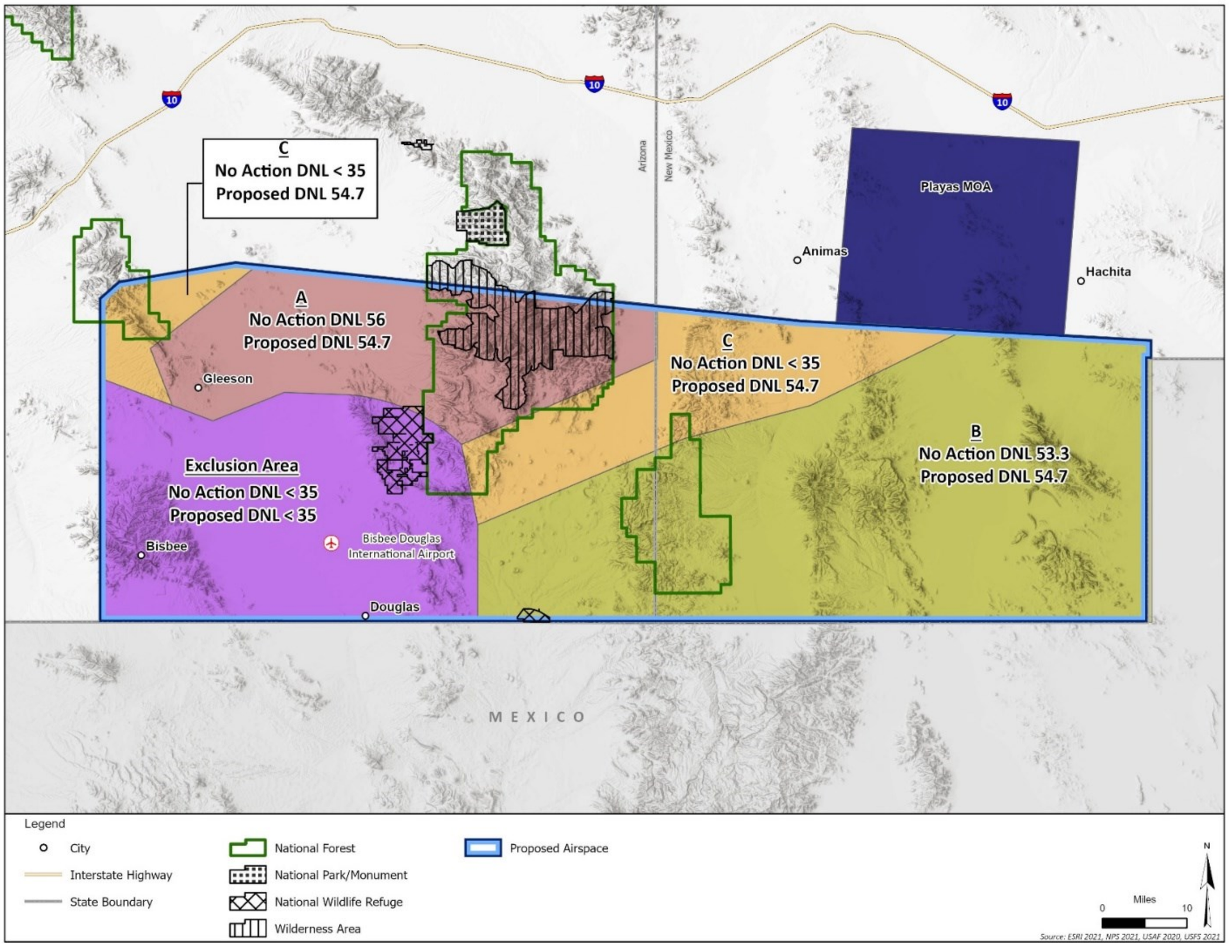
Legend: dB = decibel; DNL = Day-Night Sound Level; FAA = Federal Aviation Administration; L_{dnmr} = Onset-Rate Adjusted Day-Night Average Sound Level; MOA=Military Operations Area; N/A = Not Applicable.

Source: Stantec 2023.

For subsonic noise, Alternative 3 is the same as Alternative 2 for all of the MOAs except for the Jackal, Jackal Low, and Tombstone MOAs. Alternative 3 includes lowering the floor of the Jackal MOA to 100 feet AGL which is the reason for the increase in noise exposure in this location. Note that the Jackal Low MOA would be absorbed by the lowered floor of the Jackal MOA.

FAA Order 1050.1F defines as significant a 1.5 dB increase 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. None of the MOAs would have an increase defined as significant per FAA Order 1050.1F. A "reportable impact" is defined as a change in noise level of DNL 3 dB or more for DNL 60 dB to less than DNL 65 dB and a change in noise level of DNL 5 dB or more for DNL 45 dB to less than DNL 60 dB. Thus, the change in noise exposure would be "reportable" in Tombstone C, Jackal, and Bagdad/Gladden MOAs given the noise increases exceed 5 dB.

Figure 3.4-9 provides an illustration of the changes reported in **Table 3.4-19** for the Tombstone MOA since this MOA consists of multiple components with varying results. There would be minor changes in noise exposure in the existing Tombstone A with a reduction of 1.3 dB DNL and a very minor increase of L_{dnmr} of 0.2 dB. Tombstone B shows an increase of 1.4 dB DNL and an increase of 2.9 dB for L_{dnmr}. Areas beneath Tombstone C that are outside of Tombstone A and B and the current exclusion area around the Bisbee Douglas Airport (color coded light orange on **Figure 3.4-9**) would experience more noise exposure than they do currently, as shown in **Table 3.4-19**. These areas currently do not experience low-level overflights, but under Alternative 3 (like with Alternative 2 – Proposed Action), the MOA floor would be lowered to 100 feet AGL which would generate a noticeable difference in noise exposure. MRNMap software does not calculate values below 35 dB due to difficulty of accurately predicting very low noise levels. Because of this, noise levels attributed to aircraft that range from zero to 34 dB are reported as "< 35 dB." Therefore, a specific "change" in Tombstone C cannot be quantified since the exact value below 35 dB is not known. It can be assumed that the change would be at least 20 dB DNL or 21 dB L_{dnmr}. The noise impact in sensitive areas would be considered "reportable" by FAA regulations (FAA Order 1050.1F). There would be no change to noise exposure to the exclusion area of the Tombstone MOA.



Legend: DNL = Day-Night Average Sound Level; MOA = Military Operations Area.

Figure 3.4-9 Subsonic Noise Exposure Changes in Tombstone MOA – Alternative 3

__Supersonic Noise Exposure__

Table 3.4-20 shows the number of supersonic sorties that would occur under Alternative 3. This table also shows the authorized altitudes for supersonic operations within the different MOAs/ATCAAs. Alternative 3 proposes to lower the supersonic floor to 5,000 feet AGL in Tombstone, Jackal, Outlaw, Morenci, and Reserve which is the same as described under Alternative 2 – Proposed Action. The only minor difference would be the estimated number of sorties that include supersonic speed in the Tombstone, Jackal, and Outlaw MOAs. Under Alternative 3, the number of sorties with supersonic flight would be slightly less than Alternative 2 – Proposed Action in the Tombstone MOA (-11) and slightly higher in the Jackal/Outlaw MOAs (+154). These minor changes would not affect the CDNL contours shown for Alternative 2 – Proposed Action. Thus, the supersonic noise exposure under Alternative 3 would be the same as Alternative 2 – Proposed Action (**Section 3.4.3.2**), with no levels anticipated to exceed 62 dBC CDNL.

As with CDNL contours described above, the potential overpressures produced from sonic booms under Alternative 3 would be the same as those described for Alternative 2.

Table 3.4-20 Annual Supersonic Sorties – Alternative 3

MOA/ATCAA	Supersonic Sorties[1]		Minimum Authorized Altitude
	Percent of Total	Number	
Tombstone	1	69	5,000 feet AGL
Jackal/Outlaw	14	1,079	5,000 feet AGL
Morenci/Reserve	11	446	5,000 feet AGL
Gladden/Bagdad	66	6,019	10,000 feet MSL (existing authorization)
Sells	60	10,686	10,000 feet MSL (existing authorization)
Ruby/Fuzzy	0	0	Not Authorized

Notes: [1]Supersonic speed does not occur for the duration of the sortie, but rather during one or more 30-60 second increments.

Legend: AGL = above ground level; ATCAA = Air Traffic Control Assigned Airspace; MOA = Military Operations Area; MSL = mean sea level.

3.4.3.5 Alternative 4

This section details the noise exposure from aircraft-generated noise for Alternative 4 as well as providing a comparison to Alternative 1 – No Action.

Subsonic Noise Exposure

Table 3.4-21 shows the total sorties, nighttime sorties and those that occur during acoustical night for Alternative 4.

Table 3.4-21 Total Sorties and Nighttime Sorties – Alternative 4

MOA/ATCAA	Total Sorties	Nighttime Sorties[1]		Acoustical Night Sorties[2]	
		Percent	Number	Percent	Number
Tombstone	8,000	11	880	2	171
Outlaw/Jackal	6,610	11	727	1	63
Morenci/Reserve	4,050	10	405	1	32
Gladden/Bagdad	9,120	12	1,094	0	42
Sells	17,810	15	2,672	2	331
Ruby/Fuzzy	7,610	10	761	1	71

Notes: [1]Night sorties are those flights that occur after sunset.
[2]Acoustical night is defined as 10:00 p.m. to 7:00 a.m. Percentages in this table have been rounded up to the nearest whole number.

Legend: ATCAA = Air Traffic Control Assigned Airspace; MOA = Military Operations Area.

Table 3.4-22 shows the L_{dnmr} and DNL levels for the No Action and Alternative 4 within the MOAs. Since the proposed sorties within each MOA under Alternative 4 would be the same as Alternative 2 – Proposed Action, the subsonic noise exposure discussion is the same as **Section 3.4.3.2**. For the reasons and criteria outlined in that section, there would be a "reportable" noise impact in areas of Tombstone C, Tombstone Expansion, Jackal, Jackal Low, Bagdad, and Gladden MOAs.

Table 3.4-22 Noise Levels Attributable to Military Aircraft Operations - Alternative 4

MOA	Alternative 1 - No Action		Alternative 4		Change		FAA Determination of Impact in Noise Sensitive Areas
	DNL (dB)	L_{dnmr} (dB)	DNL (dB)	L_{dnmr} (dB)	DNL (dB)	L_{dnmr} (dB)	
Tombstone A	56.0	56.0	53.6	55.1	-2.4	-0.9	Not significant
Tombstone B	53.3	53.3	53.6	55.1	0.3	1.8	Not significant
Tombstone C[1]	<35	<35	53.6	55.1	18 (approximate)	20 (approximate)	Reportable

MOA	Alternative 1 - No Action		Alternative 4		Change		FAA Determination of Impact in Noise Sensitive Areas
	DNL (dB)	L_{dnmr} (dB)	DNL (dB)	L_{dnmr} (dB)	DNL (dB)	L_{dnmr} (dB)	
Tombstone (Proposed Expansion)[2]	--	--	53.6	55.1	--	--	Reportable
Tombstone (Exclusion Area)	<35	<35	<35	<35	0	0	Not significant
Jackal	37.3	37.3	47.3	47.7	10	10	Reportable
Jackal Low	48.6	49.7	55.8	59.1	7	9	Reportable
Outlaw	37.8	37.8	42.5	42.5	5	5	Not significant
Morenci	42.4	42.4	43.1	43.1	1	1	Not significant
Reserve	38.6	38.6	39.2	39.2	1	1	Not significant
Gladden/Bagdad	50.5	50.5	57.6	58.0	7	8	Reportable
Sells	48.5	48.5	49.3	49.3	1	1	Not significant
Fuzzy	57.8	58.6	59.6	60.5	2	2	Not significant
Ruby	44.7	44.7	46.4	46.4	2	2	Not significant

Notes: [1]MRNMap software does not calculate values below 35 dB due to difficulty of accurately predicting very low noise levels. Because of this, noise levels attributed to aircraft that range from zero to 34 dB are reported as "< 35 dB." Thus, a "change" cannot be quantified since the exact DNL is unknown. In this table, the change shown is the difference from 35 dB and is an approximate value.
[2]MRNMap calculates DNL/L_{dnmr} for military aircraft activity. There is currently no military aircraft activity in the proposed expansion area of Tombstone, thus there is no modeled DNL or L_{dnmr} to calculate a "change."

Legend: dB = decibel; DNL = Day-Night Sound Level; L_{dnmr} = Onset-Rate Adjusted Day-Night Average Sound Level; MOA=Military Operations Area.

Source: Stantec 2023.

<u>Supersonic Noise Exposure</u>

Table 3.4-23 shows the number of supersonic sorties that would occur under Alternative 4.

Table 3.4-23 Annual Supersonic Sorties – Alternative 4

MOA/ATCAA	Supersonic Sorties[2]		Minimum Authorized Altitude
	Percent of Total	Number	
Tombstone	1	80	10,000 feet AGL
Jackal/Outlaw	14	925	10,000 feet AGL
Morenci/Reserve	11	446	10,000 feet AGL
Gladden/Bagdad	66	6,019	10,000 feet MSL (existing authorization)
Sells	60	10,686	10,000 feet MSL (existing authorization)
Ruby/Fuzzy	0	0	Not Authorized

Note: [1] Supersonic speed does not occur for the duration of the sortie, but rather during one or more 30–60 second increments.

Legend: AGL = Above Ground Level; ATCAA=Air Traffic Control Assigned Airspace; MOA=Military Operations Area; MSL = Mean Sea Level.

The supersonic noise in Gladden/Bagdad and Sells would be the same as illustrated in Alternative 2 – Proposed Action. The supersonic noise in Tombstone MOA is too low to accurately model due to the low number of supersonic operations in this MOA under this Alternative. **Table 3.4-24** shows the maximum CDNL from military aircraft supersonic operations within each MOA under Alternative 4. No levels are anticipated to exceed 62 dBC CDNL.

Table 3.4-24 Supersonic Noise from Military Aircraft – Alternative 4

MOA/ATCAA	Alternative 1 – No Action Maximum CDNL (dBC)	Alternative 4 Maximum CDNL (dBC)	Change (dBC)
Tombstone[1]	N/A	<35	N/A
Jackal/Outlaw/Morenci/Reserve	35	43	8
Gladden/Bagdad	50	52	2
Sells[2]	55	55	<1

Notes: [1]Tombstone is authorized for supersonic operations under the No Action but currently no supersonic operations occur. The CDNL under Alternative 4 is too low to model, thus a specific change is not calculable.
[2]The CDNL values for Alternative 1 and Alternative 4 in Sells MOA both round to 55, although there is a small difference of less than 1 dBC.
Legend: ATCAA = Air Traffic Control Assigned Airspace; CDNL = C-weighted Day-Night Average Sound Level; dBC = C-weighted decibel; MOA = Military Operations Area; N/A = Not Applicable.
Source: Stantec 2023.

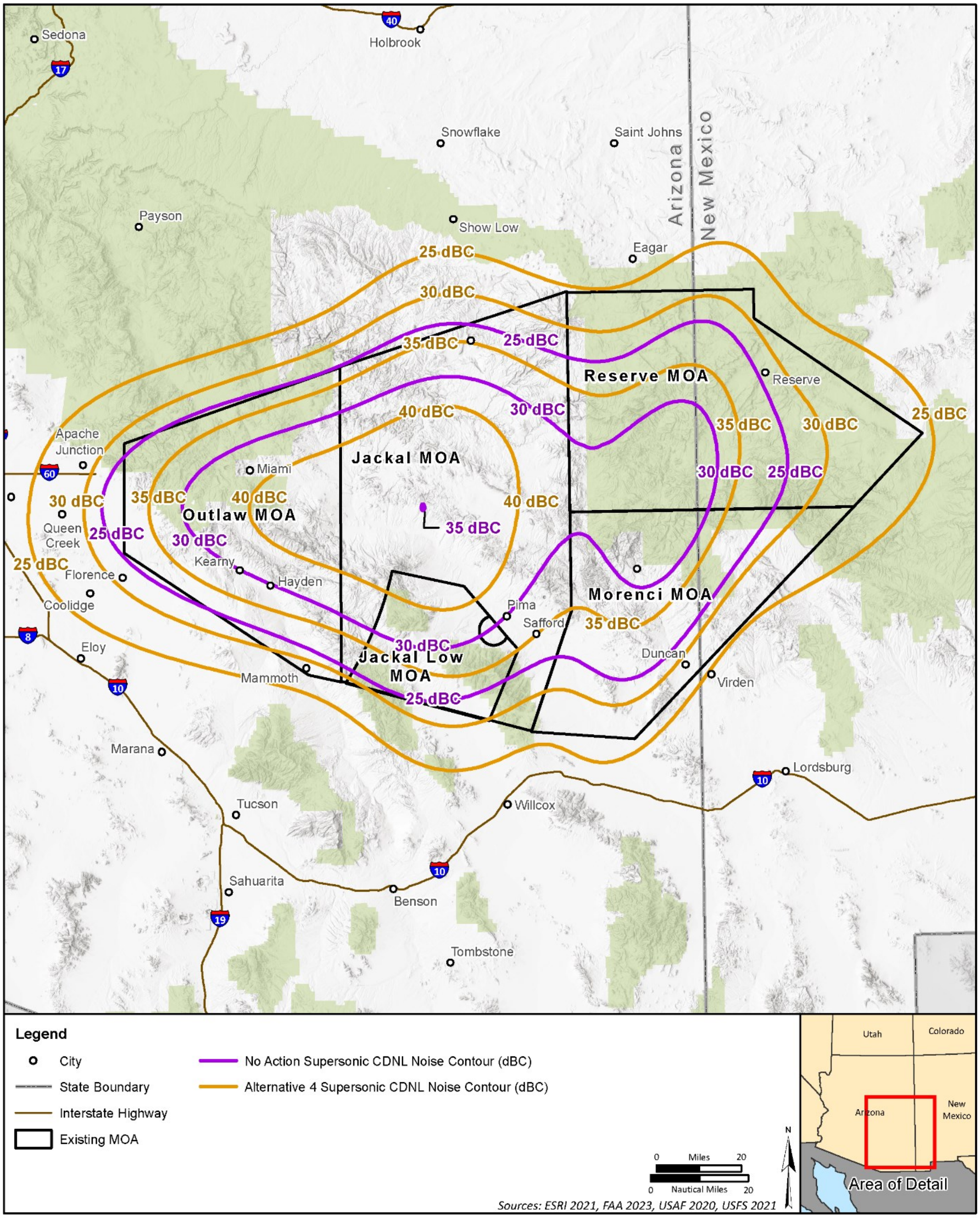
Figure 3.4-10 shows the Alternative 4 CDNL contours for the Jackal, Outlaw, Morenci, and Reserve MOAs, compared to the No Action CDNL contours. Under Alternative 4, the CDNL is approximately 8 dBC greater than under Alternative 1 – No Action. The highest CDNL level in these four MOAs would only be 43 dBC, well below the level expected to cause annoyance. It should be noted that additional contours depicting 30 and 25 dBC CDNL are also shown for consistency among all the figures in this section, but these are very low levels not normally reported.

Under Alternative 4, the minimum altitudes for supersonic activity in Tombstone, Outlaw, Jackal, Morenci, and Reserve MOAs would lower from FL300 to 10,000 feet AGL. This would result in increased overpressures from sonic booms, but at a lesser degree than those described under Alternative 2. At the proposed minimum altitude (10,000 feet AGL), an F-16C would produce maximum overpressure ranging of 4.7 psf (**Table 3.4-25**). This represents an increase of 3.1 psf over the No Action Alternative. Similarly, the F-35A at the proposed minimum altitude (10,000 feet AGL) would produce maximum overpressure of 5.3 psf. This results in increases of 3.5 psf over the No Action Alternative. See **Section 3.10.3**, *Cultural Resources, Environmental Consequences*, for information concerning structural damage from sonic booms.

Table 3.4-25 Maximum Sonic Boom Overpressures[1] – Alternative 4

MOA	Alternative 1 – No Action		Alternative 4			
	F-16	F-35	F-16	Change from No Action	F-35	Change from No Action
Tombstone	1.6	1.8	4.7	3.1	5.3	3.5
Outlaw/Jackal/Morenci/Reserve	1.6	1.8	4.7	3.1	5.3	3.5

Note: [1]Calculations based on lowest possible altitude with speed of Mach 1.4.
Legend: MOA = Military Operations Area.



Legend: CDNL = C-weighted Day-Night Average Sound Level; dBC = C-weighted decibel; MOA = Military Operations Area.

Figure 3.4-10 CDNL Contours for Jackal/Outlaw/Morenci/Reserve MOAs – Alternative 4

3.4.4 Cumulative Impacts

As shown in **Appendix G**, several actions have changed the aircraft use of MOAs in the past years and this activity has been accounted for in the No Action Alternative and all alternatives. Other activities in the region may produce localized and temporary noise, primarily from ground disturbing activities such as construction and blast noise from extractive industries (such as the Suma Silver Mining in Catron County, New Mexico), as well as noise from low-flying civilian and military aircraft and helicopters. Flight operations associated with the Off-Installation Transit and Training for Marine Corps Installations West may occur in the Tombstone or Playas MOAs if that project moves forward. The exact details on the timeline, frequency, aircraft types, or operations associated with this training are not known; however, they are expected to be temporary and the associated noise they would produce would be covered under the transient aircraft activity assessed in this EIS. Thus, the impacts of the Proposed Action and alternatives on the noise environment, when considered with past, ongoing, and reasonably foreseeable activities would not be significant nor would they result in noise exposure considered generally incompatible with FICUN standards for residential, public use, or recreational and entertainment areas.

3.4.5 Mitigations

The resulting DNL and CDNL does not exceed significance thresholds, thus there are no land use restrictions or mitigations required for noise exposure. Measures to reduce or minimize impacts from noise exposure on cultural and biological resources established through consultation with regulatory agencies are discussed in those specific sections.

3.5 AIR QUALITY

3.5.1 Resource Definition and Regulatory Framework

Air quality is defined by ambient air concentrations of specific pollutants determined by the USEPA to be of concern with respect to the health and welfare of the public. For this analysis, air quality impacts are assessed against national standards for ambient air quality and hazardous air pollutants (HAPs) as well as contributions to greenhouse gas (GHG) emissions.

3.5.1.1 Criteria Pollutants

The major pollutants of concern, called "criteria pollutants," are carbon monoxide (CO), sulfur dioxide (SO_2), nitrogen dioxide (NO_2), ozone (O_3), total suspended particulate matter less than or equal to 10 (PM_{10}) and 2.5 ($PM_{2.5}$) micrometers in aerodynamic diameter, and lead (Pb). The USEPA has established National Ambient Air Quality Standards (NAAQS) for these pollutants as shown in **Table 3.5-1**.

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

Table 3.5-1 National Ambient Air Quality Standards

Pollutant		Primary/ Secondary	Averaging Time	Level	Form
CO		primary	8 hours	9 parts per million	Not to be exceeded more than once per year
			1 hour	35 parts per million	
Pb		primary and secondary	Rolling 3-month period	0.15 micrograms per cubic meter[1]	Not to be exceeded
NO_2		primary	1 hour	100 parts per billion	98th percentile of 1-hour daily maximum concentrations, averaged over 3 years
		primary and secondary	1 year	53 parts per billion[2]	Annual mean
O_3		primary and secondary	8 hours	0.070 parts per million[3]	Annual fourth-highest daily maximum 8-hour concentration, averaged over 3 years
Particle pollution	$PM_{2.5}$	primary	1 year	12.0 micrograms per cubic meter	Annual mean, averaged over 3 years
		secondary	1 year	15.0 micrograms per cubic meter	Annual mean, averaged over 3 years
		primary and secondary	24 hours	35 micrograms per cubic meter	98th percentile, averaged over 3 years
	PM_{10}	primary and secondary	24 hours	150 micrograms per cubic meter	Not to be exceeded more than once per year on average over 3 years
SO_2		primary	1 hour	75 parts per billion[4]	99th percentile of 1-hour daily maximum concentrations, averaged over 3 years
		secondary	3 hours	0.5 parts per million	Not to be exceeded more than once per year

Notes: [1]In areas designated nonattainment for the lead standards prior to the promulgation of the current (2008) standards, and for which implementation plans to attain or maintain the current (2008) standards have not been submitted and approved, the previous standards (1.5 micrograms per cubic meter as a calendar quarter average) also remain in effect.

[2]The level of the annual nitrogen dioxide standard is 0.053 parts per million. It is shown here in terms of parts per billion for the purposes of clearer comparison to the 1-hour standard level.

[3]Final rule signed October 1, 2015, and effective December 28, 2015. The previous (2008) ozone standards additionally remain in effect in some areas. Revocation of the previous (2008) ozone standards and transitioning to the current (2015) standards will be addressed in the implementation rule for the current standards. Additionally, some areas may have certain continuing implementation obligations under the prior revoked 1-hour (1979) and 8-hour (1997) O3 standards.

[4]The previous sulfur dioxide standards (0.14 parts per million 24-hour and 0.03 parts per million annual) will additionally remain in effect in certain areas: (1) any area for which it is not yet 1 year since the effective date of designation under the current (2010) standards, and (2) any area for which implementation plans providing for attainment of the current (2010) standard have not been submitted and approved and which is designated nonattainment under the previous sulfur dioxide standards or is not meeting the requirements of a State Implementation Plan call under the previous sulfur dioxide standards (40 Code of Federal Regulations 50.4(3)). A State Implementation Plan call is a USEPA action requiring a state to resubmit all or part of its State Implementation Plan to demonstrate attainment of the require National Ambient Air Quality Standards.

Legend: CO = carbon monoxide; NO_2 = nitrogen dioxide; O_3 = ozone; Pb = lead; $PM_{2.5}$ = particulate matter less than or equal to 2.5 microns; PM_{10} = particulate matter less than or equal to 10 microns; SO_2 = sulfur dioxide.

Source: USEPA 2023a.

3.5.1.2 Hazardous Air Pollutants

In addition to the NAAQS for criteria pollutants, national standards exist for HAPs, which are regulated under Section 112(b) of the 1990 Clean Air Act (CAA) Amendments.

Aircraft gas turbine engines burn fuel more efficiently than most mobile sources. Because most fuel is consumed at higher power settings and most operational time is spent at cruise, greater than 99 percent of fuel undergoes complete combustion and is efficiently converted to carbon dioxide (CO_2) and water. HAP emissions are greatest under idle conditions when the engines are operating in a less efficient cycle (USEPA 2009). This condition would occur in the airfield environment and not within airspace. There are no proposed changes to airfield environments; therefore, HAPs are not addressed further in this EIS.

3.5.1.3 General Conformity Rule

The USEPA designates an area as in attainment when it complies with the NAAQS. Areas that violate these ambient air quality standards are designated as nonattainment areas. Areas that have improved air quality from nonattainment to attainment are designated as maintenance areas but are still required to demonstrate the ability to maintain attainment of the standards for 20 years following the redesignation to attainment. Areas that lack monitoring data to demonstrate attainment or nonattainment status are designated as unclassified and are treated as attainment areas for regulatory purposes. When an area is designated in nonattainment and/or in maintenance, the CAA Section 176(c), *General Conformity Rule*, is applied. The intent of this rule is to ensure that Federal actions do not adversely affect the timely attainment of air quality standards in areas of nonattainment or maintenance.

3.5.1.4 Greenhouse Gas Emissions

GHGs are gases that trap heat in the atmosphere. Both natural processes and human activities generate these emissions. Each GHG is assigned a global warming potential, which is the ability to trap heat, and is standardized to CO_2, which has a global warming potential value of one. A GHG is multiplied by its global warming potential to calculate the total equivalent emissions of carbon dioxide (CO_2e). The accumulation of GHGs in the atmosphere regulates the earth’s temperature. Observations show that warming of the climate is unequivocal. The global warming observed over the past 50 years is due primarily to human-induced emissions of heat-trapping gases. These emissions come mainly from the burning of fossil fuels (coal, oil, and gas), with contributions from forest clearing, agricultural practices, and other activities. The potential effects of proposed GHG emissions are by nature global and result in cumulative impacts because most individual anthropogenic sources of GHG emissions are not large enough to have a noticeable effect on climate change. To minimize GHG impacts, Federal agencies and installations are required to comply with Federal climate change policies.

EO 14008, *Tackling the Climate Crisis at Home and Abroad* (Federal Register Vol 86, No. 19, pp. 7619–7633, 2021) instructs agency heads to prepare Climate Action Plans for their agency operations. The DAF published their Climate Action Plan in October 2022 (DAF 2022a). The plan delineates the goals and actions needed to meet the requirements of EO 14008 and EO 14057, *Catalyzing Clean Energy Industries and Jobs Through Federal Sustainability* (Federal Register Vol. 86, No. 236 pp. 70935–70943, 2021). The plan identifies the climate change priorities including but not limited to:

- ensure installation resiliency and adaptability by modernizing infrastructure and facilities;

- seamlessly integrate climate and operational considerations throughout processes, plans, and decision-making; and
- reduce fossil fuel demand of current and future weapon systems to achieve lower GHG emissions.

On January 9, 2023, CEQ published the interim guidance, *National Environmental Policy Act Guidance on Consideration of Greenhouse Gas Emissions and Climate Change*. This interim guidance has been incorporated into this EIS analysis. The guidance explains how agencies should apply NEPA principles and existing best practices to their climate change analyses.

3.5.2 Affected Environment

Arizona encompasses diverse climates and topography. The deserts in the south are some of the hottest and driest areas of the country, while the higher terrain of the Colorado Plateau in the northeast has a cooler climate, with cold winters and mild summers. The southern deserts frequently experience summer temperatures between 105 degrees Fahrenheit (°F) and 115°F. Extreme temperatures in Arizona range from a record high of 128°F at Lake Havasu City (June 29, 1994) to a record low of −40°F at Hawley Lake (January 7, 1971). The hottest year on record was 2017, with a statewide annual average temperature of 63.0°F, which is 3.3°F above the long-term (1895–2020) average. The hottest month for a U.S. city was set in July 2023 with Phoenix experiencing 31 straight days of 110°F or higher (CBS News 2023). Overall, temperatures in Arizona have risen about 2.5°F since the beginning of the 20th century. The first 21 years of this century have been the warmest period on record for the state.

Much of Arizona is characterized as arid to semiarid, with annual average precipitation ranging from less than 4 inches in the southwest to around 40 inches in the White Mountains in the east-central region. Arizona is currently in a long-term drought that has lasted more than 20 years. Long-term droughts raise the risk of wildfires, already a concern for this arid state.

For purposes of analyzing potential air quality impacts from criteria air pollutants, this section considered the volume of air extending up to the mixing height (3,000 feet AGL) and coinciding with the spatial distribution of the relevant airspaces. The mixing height is the altitude at which the lower atmosphere will undergo mechanical or turbulent mixing, producing a nearly uniform air mass. The height of the mixing level determines the volume of air within which pollutants can disperse. Pollutants that are released above the mixing height typically will not disperse downward and thus will have little or no effect on ground level concentrations of pollutants. Mixing heights at any one location or region can vary by the season and time of day, but for air quality applications, mixing height is typically defined as 3,000 feet AGL as an acceptable default value (40 CFR § 93.153[c][2]). The Tombstone, Jackal Low, Morenci, and Fuzzy MOAs are currently used for low-altitude operations. The proposed modifications of Outlaw, Jackal, Bagdad, and Gladden MOAs would allow for low-altitude operations where none exist currently. The Sells, Ruby, and Reserve MOAs are not included in the criteria emissions analysis since the floors are at or above 3,000 feet AGL and there is not a proposal to change that. Thus, there are not any aircraft operations below the mixing height in those MOAs and the Proposed Action would not change that.

Under the authority of the CAA of 1963 (42 USC § 7401) and subsequent amendments, the USEPA has divided the country into geographical regions known as Air Quality Control Regions (AQCRs) to evaluate compliance with the NAAQS. The MOAs with potential air quality impacts (MOAs with existing or proposed floors at or below the 3,000-foot mixing height) along with the underlying counties and the associated AQCRs are provided in **Table 3.5-2**. Both the Morenci and Tombstone MOAs include portions extending into New Mexico.

Table 3.5-2 Air Quality Control Regions for Low-Altitude MOAs

Airspace Location	Counties	AQCRs
Tombstone MOA[1]	Cochise (Arizona); Hidalgo and Luna (New Mexico)	Southeast Arizona Intrastate AQCR (40 CFR § 81.272) New Mexico Southern Border Intrastate AQCR (40 CFR § 81.99)
Outlaw MOA	Gila, Maricopa, Pinal (Arizona)	Central Arizona Intrastate AQCR (40 CFR § 81.271) Maricopa Intrastate AQCR (40 CFR 81.36)
Jackal MOA	Navajo, Apache, Graham, Gila, Pinal (Arizona)	Northern Arizona Intrastate AQCR (40 CFR § 81.270) Southeast Arizona Intrastate AQCR Central Arizona Intrastate AQCR
Jackal Low MOA[1]	Graham (Arizona)	Southeast Arizona Intrastate AQCR (40 CFR § 81.272)
Morenci MOA[1]	Greenlee, Graham (Arizona); Catron, Grant and Hidalgo (New Mexico)	Southeast Arizona Intrastate AQCR Southwestern Mountains – Augustine Plains Intrastate AQCR (40 CFR § 81.241) New Mexico Southern Border Intrastate AQCR
Bagdad MOA	La Paz, Mohave, Yavapai (Arizona)	Mohave-Yuma Intrastate AQCR (40 CFR 81.268) Northern Arizona Intrastate AQCR (40 CFR 81.270)
Gladden MOA	La Paz, Maricopa, Mohave, Yavapai (Arizona)	Maricopa Intrastate AQCR Northern Arizona Intrastate AQCR
Fuzzy MOA[1]	Santa Cruz, Pima (Arizona)	Southeast Arizona Intrastate AQCR Pima Intrastate AQCR

Note: [1]Denotes MOAs where low-altitude operations (less than 3,000 feet AGL) currently occur. All other MOAs are where proposed low-altitude operations would occur.

Legend: AQCR = Air Quality Control Region; CFR = Code of Federal Regulations; MOA = Military Operations Area.

GHG emissions would be relevant for all of the atmospheric horizon in all of the MOAs. GHG emissions from the entire flight path of aircraft are applicable because mixing height is not relevant for these pollutants. The GHG emission estimates are based on the average time the aircraft spends executing a sortie.

The attainment status of the counties associated with the Proposed Action is provided in **Table 3.5-3**. Refer to **Table 3.5-2** for a list of counties associated with individual MOAs.

Table 3.5-3 Attainment Status for Counties Underlying MOAs

County	O_3	CO	NO_2	SO_2	PM_{10}	$PM_{2.5}$	Pb
Pinal County	NA	A	A	NA & A/M	NA[1]	NA	NA
Cochise County	A	A	A	A/M	NA[2]	A	A
Hidalgo County (NM)	A	A	A	A	A	A	A
Luna County (NM)	A	A	A	A	A	A	A
Greenlee	A	A	A	A/M	A	A	A

County	O_3	CO	NO_2	SO_2	PM_{10}	$PM_{2.5}$	Pb
Graham	A	A	A	A	A	A	A
Catron (NM)	A	A	A	A	A	A	A
Grant (NM)	A	A	A	A	A	A	A
Navajo	A	A	A	A	A	A	A
Apache	A	A	A	A	A	A	A
Maricopa	NA	A	A	A	A	A	A
La Paz	A	A	A	A	A	A	A
Yavapai	A	A	A	A	A	A	A
Mohave	A	A	A	A	A	A	A
Gila	NA	A	A	NA	NA[2]	A	NA
Santa Cruz	A	A	A	A	NA[2]	NA	A
Pima	A	A	A	A/M	NA & A/M	A	A

Notes: [1]PM_{10} nonattainment is classified as serious in Pinal County.
[2]PM_{10} nonattainment is classified as moderate in Cochise, Gila and Santa Cruz Counties.

Legend: A = Attainment; A/M = attainment/maintenance; CO = carbon monoxide; NA = nonattainment; NM = New Mexico; NO2 = nitrogen dioxide; O_3 = ozone; Pb = lead; $PM_{2.5}$ = particulate matter less than or equal to 2.5 micrometers in diameter; PM_{10} = particulate matter less than or equal to 10 micrometers in diameter; SO_2 = sulfur dioxide.

Source: USEPA 2023b.

3.5.3 Environmental Consequences

The environmental impact methodology for air quality impacts presented in this EIS was derived by utilizing the same operational data as the noise analysis as directed by AFMAN 32-7002, *Environmental Compliance and Pollution Prevention* (4 February 2020). The air analysis for aircraft operations factors in the engine types used in the aircraft, the emission factors associated with those flight modes, and other relevant details. Criteria pollutant emissions were analyzed for flight at or below 3,000 feet AGL and GHG emissions were analyzed for the entire sortie period, regardless of flight altitude. These data are included in the DAF Air Conformity Applicability Model (ACAM) used for analysis. The ACAM results for each MOA are provided in **Appendix K**. Those results are reported in the following sections.

ACAM (version 5.0.18b) was used to provide emissions estimates for the primary aircraft that use the MOAs, which include A-10, F-16, and F-35 low-altitude operations. Transient aircraft use in the MOAs can vary but includes other fighter aircraft such as AV-8B, F-22, F-35, and F-19; helicopters including the H-60 and MV-22; and cargo aircraft, which can include the C-130. The emissions from local nonfighter and transient aircraft were assessed using the HH-60 helicopter as a surrogate to conservatively represent these users of the airspace since the HH-60 entire flight would occur in low-altitude airspace.

For fixed-wing aircraft, ACAM provides estimated air emissions from proposed Federal actions for each specific criteria and precursor pollutant as defined in the NAAQS. For aircraft, operational modes are used as the basis of the emission estimates. Emissions were calculated separately for each MOA, with the exception of lead, which is excluded from the air quality analysis of all aircraft emissions, as there are no lead emission sources associated with the Proposed Action. Helicopter emissions were estimated using the *Air Emissions Guide for Air Force Mobile Sources* (DAF 2022b).

The CAA Section 176(c), *General Conformity*, requires Federal agencies to demonstrate that their proposed activities would conform to the applicable State Implementation Plans for attainment of the NAAQS. General conformity applies to nonattainment and maintenance areas. If the emissions from a Federal action proposed in a nonattainment area exceed annual *de minimis* thresholds identified in the rule, a formal conformity determination is required of that action.

For attainment area criteria pollutants, the air quality analysis used the USEPA's Prevention of Significant Deterioration (PSD) permitting threshold of 250 tons per year as an indicator of the local significance of potential impacts to air quality. The PSD permitting threshold represents the level below which a stationary source may acceptably emit without triggering the requirement to obtain a permit. Thus, if the intensity of any net emissions increase for a Proposed Action or alternative is below 250 tons per year, the indication is the air quality impacts would not be significant for that pollutant.

3.5.3.1 Alternative 1 – No Action

Under the No Action Alternative, training operations would continue in the airspace as it is currently charted (see **Section 1.2.1, Table 1.2-1** for current airspace parameters). Low-altitude training (less than 3,000 feet AGL) and associated criteria pollutant emissions would continue to occur in the Fuzzy, Jackal Low, Morenci, and Tombstone MOAs.

3.5.3.2 Alternative 2 – Proposed Action

The Alternative 2 – Proposed Action would broaden the geographic area for low-altitude training by lowering the floors of Outlaw, Jackal, Gladden, and Bagdad MOAs. Additionally, the Tombstone A, B, and C MOA components would be combined, the floor lowered, and the northern boundary would increase. The sorties for each MOA include sorties that currently occur there and those that could occur there with optimization, to include the additional F-35s anticipated at Luke AFB. The use of the individual MOAs could fluctuate year to year. In this analysis, the number of sorties projected to occur in each MOA is increased by 10 percent to conservatively account for these minor fluctuations in training activity that would allow for flexibility in use of the MOAs as a collective regional asset and were presented in **Section 2.2.2, Table 2.2-3**.

ACAM and the DAF Air Emissions Guide for Air Force Mobile Sources (DAF 2022b) were used to estimate the changes in air emissions within the MOAs, which were then compared to the General Conformity *de minimis* thresholds for pollutants in maintenance or nonattainment areas, or PSD thresholds for pollutants in attainment areas to determine the level of effects under the General Conformity Rule and NEPA, respectively. The criteria pollutant emissions for low-altitude activities for Alternative 2 – Proposed Action are presented in **Table 3.5-4**. For Gladden/Bagdad, Jackal, and Outlaw MOAs, the change is purely additive, as there are no low-altitude flights in these MOAs currently and so current emissions are zero. For the Jackal Low MOA, there is a reduction in emissions since the proposal is to allow for low-altitude flights in more MOAs which results in a reduction of low-altitude flights in Jackal Low MOA. For Fuzzy, Morenci, and Tombstone MOAs, low-altitude flights occur under existing conditions and there would be a small net increase in the number of these flights under Alternative 2.

Table 3.5-4 Criteria Pollutant Emission Estimates for Low-Altitude Airspace Activities in Tons Per Year – Alternative 2

Airspace Area	VOCs	SO_x	NO_x	CO	PM_{10}	$PM_{2.5}$
Net Change for Jackal Low MOA	-26.49	-13.48	-239.84	-76.44	-16.11	-14.51
Exceed 250 ton/year indicator?	No	No	No	No	No	No
Net Change for Gladden/Bagdad MOAs	0.80	10.99	185.27	68.71	12.96	11.65
Exceed 250 ton/year indicator?	No	No	No	No	No	No
Net Change for Fuzzy MOA	*0.00*	*0.11*	*1.16*	*0.29*	*0.26*	*0.24*
de minimis Threshold	NA	100	NA	NA	100	NA
Exceed Threshold?		No			No	
Exceed 250 ton/year indicator?	No		No	No		No
Net Change for Jackal MOA	4.28	5.44	86.37	17.04	7.88	7.08
de minimis Threshold	100	100	NA	NA	70	NA
Exceed Threshold?	No	No			No	
Exceed 250 ton/year indicator?			No	No		No
Net Change for Outlaw MOA	4.27	4.25	65.12	14.09	6.53	5.87
de minimis Threshold	100	100	100	NA	70	100
Exceed Threshold?	No	No	No		No	No
Exceed 250 ton/year indicator?				No		
Net Change for Morenci MOA	*0.18*	0.45	6.50	1.75	0.68	0.49
de minimis Threshold	NA	100	NA	NA	NA	NA
Exceed Threshold?		No				
Exceed 250 ton/year indicator?	No		No	No	No	No
Net Change for Tombstone MOA	*1.56*	*2.71*	*34.57*	*7.33*	*5.40*	*4.85*
de minimis Threshold	NA	100	NA	NA	100	NA
Exceed Threshold?		No			No	
Exceed 250 ton/year indicator?	No		No	No		No

Legend: CO = carbon monoxide; MOA = Military Operations Area; NA = not applicable, NO_x = nitrogen oxides; PM_{10} = particulate matter less than or equal to 10 micrometers in diameter; $PM_{2.5}$ = particulate matter less than or equal to 2.5 micrometers in diameter; SO_x = sulfur oxides; VOC = volatile organic compounds.

None of the emissions from low-altitude flight in the MOAs would exceed *de minimis* thresholds in areas designated as maintenance or nonattainment for a criteria pollutant. Low-altitude flight emissions in the Gladden/Bagdad MOAs are the highest for nitrogen oxides (NO_x) at 185 tons per year. While a small portion of the Gladden MOA is located in Maricopa County, the area of Maricopa County that includes Gladden MOA is classified as attainment for O_3. Further, the emissions represent the total of all low-altitude flight across both Gladden and Bagdad MOAs, an area that covers four counties and which does not include any nonattainment or maintenance areas for O_3. As a result, the emissions are compared to the 250 ton per year indicator to assess possible significant impacts.

Similarly, those portions of Jackal and Jackal Low that lie within Gila and/or Pinal counties are in attainment for all criteria pollutants. The same scenario applies to Fuzzy MOA, which is partially located in Santa Cruz and Pima Counties, but none of the areas that underlie this MOA have attainment issues. As a result, emissions for these MOAs are compared to the 250 ton per year indicator to assess possible significant impacts.

The total emissions associated with flares are extremely small, with the highest emissions generated from all low-altitude (2,000 feet AGL) flare releases across all MOAs estimated at 0.41 tons CO_2. This calculation assumes all flares that could be released at 2,000 feet are released at that altitude which would be a worst-case scenario since flares are used throughout the altitudes during training. Details on calculations by MOA for all of the sortie flight activity can be found in **Appendix K**.

None of the emissions under Alternative 2 – Proposed Action approach or exceed the 250 ton per year significance indicator threshold for attainment areas or the applicable *de minimis* thresholds for nonattainment or maintenance areas. Based on these conclusions, the implementation of Alternative 2 – Proposed Action would not result in significant impacts to regional air quality and would conform to State Implementation Plans.

3.5.3.3 Alternative 3

Variations in sortie activity in the Jackal, Tombstone, and Outlaw MOAs would occur under Alternative 3, as identified in **Table 2.2-7**. The floor of the Jackal MOA would be lowered to 100 feet AGL consuming the airspace currently charted as Jackal Low MOA. The Jackal Low MOA would no longer exist and all low-altitude flight would occur within the vertical and horizontal boundaries of the larger Jackal MOA. For Gladden/Bagdad, Fuzzy, and Morenci MOAs, the net change is identical to Alternative 2, since flight activity proposed for Alternative 3 in these MOAs is identical to Alternative 2. For Outlaw and Tombstone MOAs, there would be a small net increase in the number of low-level flights under Alternative 3 when compared to No Action. The emission estimates are presented in **Table 3.5-5**. The number of total flares released across all the MOAs and the associated emissions would be the same as Alternative 2 – Proposed Action.

Table 3.5-5 Criteria Pollutant Emission Estimates for Low-Altitude Airspace Activities in Tons Per Year – Alternative 3

Airspace Area	VOCs	SO_x	NO_x	CO	PM_{10}	$PM_{2.5}$
Net Change for Gladden/Bagdad MOAs	0.80	10.99	185.27	68.71	12.96	11.65
Exceed 250 ton/year indicator?	No	No	No	No	No	No
Net Change for Fuzzy MOA	*0.00*	*0.11*	*1.16*	*0.29*	*0.26*	*0.24*
de minimis Threshold	NA	100	NA	NA	100	NA
Exceed Threshold?		No			No	
Exceed 250 ton/year indicator?	No		No	No		No
Net Change for Jackal MOA	5.73	11.37	150.87	31.36	21.75	19.55
de minimis Threshold	NA	100	NA	NA	70	NA
Exceed Threshold?		No			No	
Exceed 250 ton/year indicator?	No		No	No		No
Net Change for Outlaw MOA	4.36	6.22	93.94	18.27	9.84	8.85
de minimis Threshold	100	100	100	NA	70	100
Exceed Threshold?	No	No	No		No	No
Exceed 250 ton/year indicator?				No		
Net Change for Morenci MOA	0.18	0.45	6.50	1.75	0.68	0.49
de minimis Threshold	NA	100	NA	NA	NA	NA
Exceed Threshold?		No				
Exceed 250 ton/year indicator?	No		No	No	No	No
Net Change for Tombstone MOA	*1.51*	*2.23*	*29.79*	*6.35*	*4.21*	*3.79*
de minimis Threshold	NA	100	NA	NA	100	NA
Exceed Threshold?		No			No	
Exceed 250 ton/year indicator?	No		No	No		No

Legend: CO = carbon monoxide; MOA = Military Operations Area; NO_x = nitrogen oxides; PM_{10} = particulate matter less than or equal to 10 micrometers in diameter; $PM_{2.5}$ = particulate matter less than or equal to 2.5 micrometers in diameter; SO_x = sulfur oxides; VOC = volatile organic compounds.

None of the emissions from low-altitude flight in the MOAs would exceed applicable *de minimis* thresholds in areas designated as maintenance or nonattainment for a criteria pollutant. The Jackal MOA has total estimated NO_x emissions of 151 tons per year, but none of the area underlying the MOA is located in a nonattainment area for O_3. As a result, volatile organic compound (VOC) and NO_x emissions for the Jackal MOA are analyzed under the 250 tons significance indicator threshold.

Similarly, those portions of Jackal Low that lie within Gila and/or Pinal Counties are in attainment for all criteria pollutants. The same scenario applies to Fuzzy MOA, which is partially located in Santa Cruz and Pima Counties, but none of the areas that underlie this MOA have attainment issues. As a result, emissions for these MOAs are compared to the 250 ton per year indicator to assess possible significant impacts.

The Phoenix-Mesa O_3 nonattainment area at its closest boundary is approximately 35 miles to the west of the Outlaw MOA. A review of predominant wind patterns at Mesa Falcon Field (Iowa State University 2023) indicates that the predominant wind directions are from the west in winter and from the northeast in the warm months, indicating that pollutant dispersion from the MOA would primarily track in these directions, and not directly impact the nonattainment area.

None of the criteria pollutant emissions approach or exceed the 250 ton per year significance indicator threshold for attainment areas under Alternative 3. Based on these conclusions, the implementation of Alternative 3 would not result in significant impacts to regional air quality and would conform to State Implementation Plans.

3.5.3.4 Alternative 4

Low-altitude flight operations under Alternative 4 would be identical to the operations under Alternative 2. The emission estimates presented in **Table 3.5-4** are the same for Alternative 4.

3.5.4 Cumulative Impacts

3.5.4.1 Criteria Pollutants

The ROI for criteria pollutants comprises several counties throughout Arizona and a small portion of New Mexico. A number of the Arizona counties have nonattainment or maintenance area designations for all or part of the county, as indicated in **Table 3.5-3**. Reasonably foreseeable future actions that include low-altitude aircraft operations have the potential to interact with the proposed low-altitude airspace activities and affect air quality. Known reasonably foreseeable actions that could impact activities in the MOAs include the 4th Generation Missions Regional Realignment proposed for Davis-Monthan AFB in Tucson, Arizona and the Off-Installation Transit and Training Program for the U.S. Marine Corps (**Appendix G**).

The 4th Generation Missions Regional Realignment would relocate several squadrons from Nellis AFB to Davis-Monthan AFB and make adjustments to some of the existing units stationed at Davis-Monthan AFB. This action would result in an increase of 18 HH-60G aircraft stationed at Davis-Monthan AFB. The estimated change in emissions for HH-60G training activities in the MOAs is presented in **Table 3.5-6**, and these would be considered additional training activities to the flight activities analyzed in this EIS. There is not enough information known about the frequency, types of aircraft, or proposed operations associated with the Off-Installation Transit and Training Program for the U.S. Marine Corps to do a quantitative analysis. However, it is expected that use of the Playas MOA and Tombstone MOA for this training would be infrequent and covered under the transient aircraft included in this analysis, thus there would be no significant cumulative impact to air quality.

Table 3.5-6 4th Generation Missions Regional Realignment Helicopter Emission Estimates for Low-Altitude Airspace Activities in Tons Per Year

Affected MOAs	NO_x	SO_x	CO	VOC	PM_{10}	$PM_{2.5}$	CO_2e
Tombstone	4.43	0.41	1.09	0.00	1.01	0.90	1,247
Jackal Low	1.12	0.10	0.27	0.00	0.26	0.23	315
Morenci	0.86	0.08	0,21	0,00	0.20	0.17	241
Fuzzy	1.22	0.11	0.30	0.00	0.28	0.25	344

Legend: CO = carbon monoxide; CO_2e = carbon dioxide equivalent; MOA = Military Operations Area; NO_x = nitrogen oxides; PM_{10} = particulate matter less than or equal to 10 micrometers in diameter; $PM_{2.5}$ = particulate matter less than or equal to 2.5 micrometers in diameter; SO_x = sulfur oxides; VOC = volatile organic compounds.

The addition of the training emissions associated with the HH-60Gs to those analyzed in this EIS would not result in exceedances of any applicable General Conformity *de minimis* thresholds or the 250 ton per year indicator threshold. As a result, the addition of these emissions would not be expected to produce significant cumulative impacts to air quality.

3.5.4.2 GHGs and Climate Change

For GHGs, the ROI is global and impacts are cumulative by nature. The cumulative analysis evaluates emissions considering the existing conditions and the Proposed Action alternatives. Implementation of any of the possible alternatives would contribute directly to emissions of GHGs from the combustion of fossil fuels. GHG emissions for these alternatives and the No Action Alternative were estimated for all the annual training hours anticipated (i.e., those above and below the 3,000 feet AGL mixing height) and are provided in **Table 3.5-7**. These estimates were prepared to provide a measure of the difference between the Proposed Action alternatives. The lifetime GHG emission analysis for the aircraft is a 15-year period from implementation of the airspace optimization in 2025 (estimated) to 2040. This timeframe was selected based on the range of service for the aircraft analyzed for this EIS: the current extension of A-10 service to 2040 (15 years), the current extension of the F-16 C/D service to 20 years, and the anticipated service of the F-35A to exceed 50 years. Detailed calculations and assumptions are included in **Appendix K**.

Table 3.5-7 GHG Emissions Estimates for All Alternatives (thousands of tons per year)

	CO_2e in thousands of tons	CO_2e in thousands of metric tons
Annual Alternative 1 – No Action	866.3	785.9
15-year lifecycle emissions for all aircraft	12,995	11,789
Annual Alternatives 2 – 4	1,019.7	925.0
15-year lifecycle emissions for all aircraft	15,295	13,875
Annual GHG net change	*153.3*	*139.1*
15-year net change lifecycle emissions	**2,300**	**2,086**

Legend: CO_2e = carbon dioxide equivalent; GHG = greenhouse gas.

The social costs of CO_2, methane, and nitrous oxide (N_2O) allow agencies to understand the benefits of reducing each of these GHGs, or the social costs of increasing such emissions, in the decision-making process. Collectively, these are referenced as the social cost of greenhouse gas emissions (SC-GHG) and is defined as the monetary value of the net harm to society associated with adding a small amount of carbon to the atmosphere in a given year. In principle, net harm cost includes the value of all climate change impacts, including but not limited to changes in net agricultural productivity, human health effects, property damage from increased flood risk natural disasters, disruption of energy systems, risk of conflict, environmental migration, and the value of ecosystem services (Interagency Working Group [IWG] 2021).

For this analysis, only social cost of carbon dioxide (SC-CO_2) is evaluated as the vast majority of emissions are generated by aircraft flying with turbofan engines. These engines generate no methane emissions and very little N_2O emissions.

For the reasons indicated above, the SC-CO_2 analysis covers a 15-year period from 2025 to 2040. **Table 3.5-8** identifies the projected cost, in 2020 dollars, of maintaining the No Action Alternative (Alternative 1), or implementing Alternatives 2 through 4, using a 2.5 percent average discount (IWG 2021). These costs are totaled in **Table 3.5-8** for the presumed first year of steady state operations (2025) and the year 2040 to provide an indication of the increasing monetary value of net harm on an annual basis. The total sum of estimated monetary value of damages, based on the annual net change between the No Action and Proposed Action alternatives for the entire 15-year period evaluated would be $206,836,609. For a more detailed presentation of the DAF approach to the SC-GHG analysis, the full ACAM report is included in **Appendix K** for both Alternatives 2 and 3.

Table 3.5-8 SC-CO_2 Select Yearly Estimates for Emissions Increase Over 15 Years

Year	[1]SC-CO_2 Estimates (2020$/Metric Ton @ 2.5% average damages) (in millions)	Proposed Action Annual Net Change Emissions in Metric Tons	SC-CO_2 Emissions 2020$ – 2.5% average discount, average damages for individual year
2025	$ 82.95	139,089	$11,537,572
2040	$ 103.11		$14,341,884

Note: [1]Values from Office of Management and Budget 2021; represented here rounded to standard currency values.
Legend: SC-CO_2 = social cost of carbon dioxide.

There are a number of limitations associated with the modeling used to derive the monetary values presented in **Table 3.5-8** due to the broad scope of scientific and economic issues across the complex global landscape (IWG 2021). Nonetheless, providing a monetary characterization of GHG impacts is a useful tool for generally assessing impacts from the emissions.

Operational energy (aviation fuel and energy to power aircraft) comprises over 80 percent of the DAF's energy use. Life-cycle emissions for the Proposed Action assume no changes in operations from 2025 to 2040. However, likely reductions across all DAF operations would include reductions in ground mobile source emissions as vehicles and equipment continue to be electrified, and as the DAF implements its Climate Action Plan.

A widely discussed opportunity for mitigation of non-CO_2 emissions from aviation is the avoidance of persistent contrails that can form contrail cirrus. If the conditions are suitable, emissions of soot and water vapor can trigger the formation of contrails, which can spread to form extensive contrail-cirrus cloud coverage. Contrails only form in ice-supersaturated air below a critical temperature threshold (Kärcher 2018). Such cloud coverage is estimated to result in a significant portion of the effective radiant forcing in global aviation, and as such is the largest contributor (57 percent) to global warming from aviation activities (Lee et al. 2021). It is therefore feasible to alter flight trajectories to avoid such areas conducive to contrail formation, since ice-supersaturated areas tend to be tens to hundreds of kilometers in the horizontal and only a few 100 meters in the vertical extent (Gierens et al. 1997). However, meteorological models cannot currently predict the formation of persistent contrails with sufficient accuracy in time and space (Gierens et al. 2020); this mitigation option is speculated to take up to a decade to mature.

Reduction of fuel use offers the most significant opportunity to optimize operational capability while simultaneously reducing GHG emissions. Technological enhancements to achieve this reduction include but are not limited to aerodynamic advancements, streamlined flight planning, incorporation of drag reduction technologies onto current platforms, enhanced engine sustainment practices, and increases in the use of simulation and augmented reality systems. Additionally, the DAF has instituted an installations portfolio goal of net-zero emissions by Fiscal Year 2046 (DAF 2022a). During the estimated 15-year life cycle of the Proposed Action, many activities would be incorporated into the DAF functions to reduce GHG emissions across the DAF assets.

3.5.5 Mitigations

The emission estimates associated with the Proposed Action do not exceed established thresholds for significance. The Proposed Action would not affect the attainment status of any location, thus there are no mitigations required.

3.6 Natural Resources

3.6.1 Definition of Resource and Regulatory Framework

For this analysis, natural resources are defined as wildlife, domestic animals, and special-status species, those protected under Federal and state law, and the habitats within which they occur. Vegetation would not be affected by the Proposed Action, which involves only changes to airspace and no ground disturbing activities; therefore, vegetation will be discussed only in the context of wildlife habitat.

Wildlife includes all animal species (invertebrates, fish, amphibians, reptiles, birds, and mammals) with the exception of those identified as special-status species. These groups all perceive noise disturbances differently. For example, most invertebrates hear poorly in the frequency range of aircraft noise. One study supports the hypothesis that birds, frogs, and toads tend to shift their vocalizations to higher frequencies in response to man-made noise but generally, little is known about the effects of noise on reptiles and amphibians because response is difficult to study since their heartrates are naturally variable and they do not demonstrate a startle response (Roca et al. 2016; Bowles 1995a). Snakes, turtles, and tortoises hear poorly while amphibians are sensitive to vibration and hearing capacities vary more widely (Bowles 1995a). Few field studies on small mammals have been conducted, but those that have suggest no population level effects from airport noise (Bowles 1995a). Due to the nature of the Proposed Action, and the fact that no ground disturbance would occur under the airspace, no effects to reptiles, small mammals (except bats), amphibians, fish, and invertebrates, or their associated habitats are anticipated. Large mammals, bats, and birds are potentially affected by noise; therefore, the wildlife section will focus on those species.

Special-status species in this EIS include animal species: (1) listed as endangered, threatened, or proposed for listing by the USFWS under the ESA and their designated critical habitats; (2) protected by the Federal Migratory Bird Treaty Act (MBTA); (3) protected under the Bald and Golden Eagle Protection Act (BGEPA); or (4) listed under state conservation laws.

Under the ESA, it is the responsibility of the action proponent to determine whether a proposed action "may affect" endangered, threatened, or proposed species, or designated critical habitat. If the action proponent determines it may affect a listed species, they must consult with the USFWS. If the action proponent determines their proposed action would have "no effect" on listed species or their habitat, they do not need to consult further with USFWS. Species proposed for listing under ESA are not protected under law. However, these species could become federally listed in the near-term, and therefore, they are considered in this analysis in order to avoid future conflicts if they were to be listed during the preparation of this EIS. Under Section 10(j) of the ESA, the USFWS can designate reintroduced populations established outside of the species' current range, but within its historical range, as "experimental." The experimental population can be designated as "essential" or "non-essential" to the continued existence of the species. The regulatory restrictions are considerably reduced for a species with a Non-essential Experimental Population designation. Critical habitat is designated by USFWS through a formal process to provide protection for those habitat areas determined to be essential to the species' conservation. Federal agencies are required to consult with the USFWS if their actions may "destroy or adversely modify" critical habitat for listed species.

The MBTA prohibits the intentional take of migratory birds, nests, and eggs, except as permitted by the USFWS Migratory Bird Office. Assessment of a project's effect on migratory birds places an emphasis on "species of concern" as defined by EO 13186, *Responsibilities of Federal Agencies to Protect Migratory Birds*.

Both the bald eagle (*Haliaeetus leucocephalus*) and golden eagle (*Aquila chrysaetos*) are protected under the MBTA and the BGEPA. The BGEPA affords both eagles protection in addition to that provided by the MBTA, in particular, making it unlawful to disturb eagles. BGEPA defines "take" as "pursue, shoot, shoot at, poison, wound, kill, capture, trap, collect, molest or disturb" and further defines "disturb" as "to agitate or bother a bald or golden eagle to a degree that causes, or is likely to cause, based on the best scientific information available, 1) injury to an eagle, 2) a decrease in its productivity, by substantially interfering with normal breeding, feeding, or sheltering behavior, or 3) nest abandonment, by substantially interfering with normal breeding, feeding, or sheltering behavior" (50 CFR 22.6).

In addition to federally protected species, the states of Arizona and New Mexico maintain lists of species that are considered important for conservation. Federal agencies are not required to consult with state agencies on potential impacts to these protected species; however, this EIS includes an analysis on potential impacts to these species for the decision-maker to consider. The New Mexico Department of Game and Fish (NMDGF) is directed under the New Mexico Wildlife Conservation Act to develop recovery plans for species listed as threatened or endangered. The AZGFD has developed a State Wildlife Action Plan that defines a wildlife conservation strategy for the state and identifies Arizona's Species of Greatest Conservation Need (SGCN) (AZGFD 2022a).

The AZGFD is a cooperating agency for this EIS and has provided subject matter expertise for species and habitats within Arizona (many of which are also applicable to New Mexico). The DAF is consulting with USFWS concerning potential impacts to species afforded protection under the ESA, MBTA, and BGEPA. The consultation documents are provided in **Appendix L**.

3.6.2 Affected Environment

3.6.2.1 Wildlife

The MOAs primarily overlie the Sonoran Basin and Range ecoregion, which is characterized by a warm and dry environment at low elevation typical to the American southwest (USEPA 2013). The area consists of low, scattered mountains. Vegetative cover is predominantly desert grassland and arid shrubland, except for high elevation islands of woodland. The northern edge of the project boundaries (under the Bagdad/Gladden MOA) runs along the Arizona and New Mexico Mountains ecoregion (USEPA 2013). These mountains are lower than those of surrounding regions, surrounded by grasslands and deserts, and hold vegetation more tolerant of much warmer and drier environments. The eastern portion of the project boundaries (under the Tombstone MOA) contains the Madrean Archipelago ecoregion, which is made up of relatively high elevation basins and ranges (USEPA 2013).

Overall, the lands below the MOAs are dominated by desert grasslands and shrublands, with woodlands in higher elevations. Common mammals found in these communities include mule deer, black-tailed jackrabbit, desert cottontail, kangaroo rats, woodrats, desert pocket gopher, javelina, mountain lion, coyote, bobcat, and black bear. Common birds include the black-throated sparrow, band-tailed pigeon, greater roadrunner, curve-billed thrasher, Chihuahuan raven, scaled quail, Gambel's quail, wild turkey, western burrowing owl, golden eagle, great horned owl, red-tailed hawk, and ferruginous hawk (Bailey 1995; AZGFD 2022b, 2022c, 2022d, 2022e).

3.6.2.2 Domestic Animals

Some of the land beneath existing and proposed airspace, including large areas of Federal lands managed by the BLM and USFS, is used for grazing and rearing of livestock and horses. The U.S. Department of Agriculture Census of Agriculture identifies cattle being the primary livestock reared in Arizona and New Mexico. Also produced are hogs, sheep and lambs, and goats (U.S. Department of Agriculture 2022a, 2022b).

3.6.2.3 Special-status Species

Federally Listed Species

This project was entered into the USFWS Information for Planning and Consultation system to produce lists of threatened, endangered, proposed, and candidate species and designated critical habitats that could occur beneath each of the MOAs. A Biological Assessment will be prepared for the Preferred Alternative and provided to USFWS for concurrence to complete the consultation process (**Appendix L**).

Federally listed wildlife species with the potential to occur below the MOAs are presented in **Table 3.6-1**. Because the Proposed Action would not involve any ground disturbance and these groups are not particularly sensitive to noise (see discussion in **Section 3.6.3.2**, *Wildlife*), federally listed amphibians, reptiles, fish, small mammals, and invertebrates are unlikely to experience any effect from the Proposed Action. Critical habitats for federally listed mammals and birds are listed in **Table 3.6-2.** The federally listed large mammal, bat, and bird species that are potentially impacted and have the potential to occur, are discussed in detail below.

Table 3.6-1 Federally Listed Wildlife with Potential to Occur Below the MOAs

Name	ESA Status	MOAs With Known Presence
Mammals		
Sonoran pronghorn *(Antilocapra americana sonoriensis)*	E, XN	Sells, Ruby, Fuzzy
Mexican wolf *(Canis lupus baileyi)*	E, XN	Bagdad, Gladden, Outlaw, Jackal, Morenci, Reserve, Tombstone, Tombstone Expanded
Mexican long-nosed bat *(Leptonycteris nivalis)*	E	Tombstone, Tombstone Expanded
Ocelot *(Leopardis pardalis)*	E	Sells, Ruby, Fuzzy, Outlaw, Reserve, Jackal, Tombstone, Tombstone Expanded
Jaguar *(Panthera onca)*	E	Sells, Ruby, Fuzzy, Tombstone, Tombstone Expanded
Mount Graham red squirrel *(Tamiasciurus hudsonicus grahamensis[1])*	E	Jackal
New Mexico meadow jumping mouse *(Zapus hudsonius luteus[1])*	E	Jackal, Reserve
Birds		
Yellow-billed cuckoo *(Coccyzus americanus)* *Western DPS	T	Bagdad, Gladden, Outlaw, Jackal, Morenci, Reserve, Sells, Ruby, Fuzzy, Tombstone, Tombstone Expanded
Southwestern willow flycatcher *(Empidonax traillii extimus)*	E	Bagdad, Gladden, Outlaw, Jackal, Morenci, Reserve, Sells, Ruby, Fuzzy, Tombstone, Tombstone Expanded
Yuma Ridgeway's rail *(Rallus obsoletus yumanensis)*	E	Bagdad, Gladden, Outlaw
Masked bobwhite *(Colinus virginianus ridgwayi)*	E	Sells, Ruby, Fuzzy
California least tern *(Sterna antillarum browni)*	E	Outlaw, Sells, Ruby, Fuzzy, Bagdad, Gladden
Mexican spotted owl *(Strix occidentalis lucida)*	T	Gladden, Outlaw, Jackal, Morenci, Reserve, Ruby, Fuzzy, Tombstone, Tombstone Expanded
Northern aplomado falcon (*Falco femoralis septentrionalis*)	XN	Outlaw, Morenci, Tombstone, Tombstone Expanded
Cactus Ferruginous Pygmy-owl (*Glaucidium brasilianum*)	T	Fuzzy, Jackal, Outlaw, Ruby, Sells
Reptiles[1]		
New Mexican ridge-nosed rattlesnake *(Crotalus willardi obscurus)*	T	Tombstone, Tombstone Expanded
Sonoyta mud turtle *(Kinosternon sonoriense longifemorale)*	E	Sells, Ruby, Fuzzy
Northern Mexican gartersnake *(Thamnophis eques megalops)*	T	Bagdad, Gladden, Outlaw, Jackal, Morenci, Reserve, Ruby, Fuzzy, Tombstone, Tombstone Expanded
Narrow-headed gartersnake *(Thamnophis rufipunctatus)*	T	Outlaw, Jackal, Morenci, Reserve
Amphibians[1]		
Chiricahua leopard frog *(Lithobates chiricahuensis)*	T	Outlaw, Jackal, Morenci, Reserve, Sells, Ruby, Fuzzy, Tombstone, Tombstone Expanded
Fish[1]		
Beautiful shiner *(Cyprinella Formosa)*	T	Tombstone, Tombstone Expanded

Name	ESA Status	MOAs With Known Presence
Desert pupfish *(Cyprinodon macularius)*	E	Jackal, Sells
Chihuahua chub *(Gila nigrescens)*	T	Tombstone Expanded
Yaqui chub *(Gila purpurea)*	E	Tombstone, Tombstone Expanded
Yaqui catfish *(Ictalurus pricei)*	T	Tombstone, Tombstone Expanded
Little Colorado spinedace *(Lepidomeda vittate)*	T	Reserve
Spikedace *(Meda fulgida)*	E	Outlaw, Jackal, Morenci, Reserve, Tombstone, Tombstone Expanded
Apache trout *(Oncorhynchus apache)*	T	Jackal, Reserve
Gila trout *(Oncorhynchus gilae)*	T	Bagdad, Gladden, Outlaw, Jackal, Morenci, Reserve, Tombstone, Tombstone Expanded
Gila topminnow *(Poeciliopsis occidentalis Occidentalis)*	E	Jackal, Reserve, Fuzzy, Gladden, Ruby, Sells, Tombstone Expanded
Loach minnow *(Tiaroga cobitis)*	E	Outlaw, Jackal, Morenci, Reserve, Tombstone, Tombstone Expanded
Razorback sucker *(Xyrauchen texanu)*	E	Outlaw, Jackal, Morenci
Sonora Chub *(Gila ditaenia)*	T	Ruby, Fuzzy
Gila Chub (*Gila intermedia*)	E	Jackal, Outlaw, Reserve, Morenci, Tombstone Expanded
Woundfin (*Plagopterus argentissimus*)	XN	Jackal, Morenci
Invertebrates[1]		
Monarch butterfly *(Danaus plexippus)*	C	Bagdad, Gladden, Ruby, Sells, Outlaw, Jackal, Morenci, Reserve, Tombstone, Tombstone Expanded
San Bernardino springsnail *(Pyrgulopsis bernardina)*	T	Tombstone, Tombstone Expanded
Three Forks springsnail *(Pyrgulopsis trivialis)*	E	Reserve

Note: [1]Due to the nature of the Proposed Action, no effects to reptiles, small mammals (with the exception of bats), amphibians, fish, and invertebrates, or their associated habitats are anticipated. Therefore, these species are not carried forward for analysis.

Legend: C: Candidate for Listing; E: Endangered; T: Threatened; PE: Proposed Endangered; XN: Experimental Nonessential Population.

Sources: AZGFD 2022b–e; USFWS 2023a–k.

Table 3.6-2 Critical Habitats Occurring Below the MOAs[1]

Species	MOAs
Jaguar	Fuzzy, Ruby, Sells, Tombstone, Tombstone Expanded
Mexican spotted owl	Ruby, Fuzzy, Jackal, Outlaw, Morenci, Reserve, Tombstone, Tombstone Expanded
Southwestern willow flycatcher	Bagdad, Gladden, Jackal, Outlaw, Morenci, Reserve
Yellow-billed cuckoo	Bagdad, Fuzzy, Ruby, Jackal, Outlaw, Morenci, Reserve, Tombstone, Tombstone Expanded
Cactus Ferruginous Pygmy-owl	Fuzzy, Jackal, Outlaw, Ruby, Sells

Note: [1]The Proposed Action would not involve any ground disturbance, thus critical habitat for federally listed amphibians, reptiles, fish, small mammals, and invertebrates is not included in this table.
Legend: MOA = Military Operations Area.
Sources*:* USFWS 2023a–j.

Sonoran pronghorn. The Sonoran pronghorn, a subspecies of the American pronghorn, was listed as endangered in 1967. No critical habitat has been designated for this species, which may occur in dry plains or deserts between southeastern California and southwestern Arizona. The species is federally protected everywhere it is found, except where it is listed as a non-essential experimental population in Arizona: an area north of Interstate 8 and south of Interstate 10, bounded by the Colorado River on the west and Interstate 10 on the east; and an area south of Interstate 8, bounded by Highway 85 on the west, Interstates 10 and 19 on the east, and the U.S.-Mexico border on the south.

Mexican wolf. The Mexican wolf, a subspecies of the gray wolf, was listed as endangered in 1976 and was designated with experimental population status in 2015. The Mexican wolf is the smallest and rarest subspecies of gray wolf in North America. Mexican wolves are found in a variety of southwestern habitats but prefer mountain woodlands. Historically, the wolves ranged throughout the mountainous regions from central Mexico, through southeastern Arizona, southern New Mexico, and southwestern Texas. However, by the mid-1900s, the wolves were effectively eliminated from the U.S. due to intensive efforts to eradicate them due to the wolves preying on livestock. As part of lengthy recovery efforts, captive-reared Mexican gray wolves were released into the wild in eastern Arizona and western New Mexico.

Mexican long-nosed bat. The Mexican long-nosed bat was federally listed as endangered in 1988. Critical habitat for this species has not been designated. Mexican long-nosed bats occur in subtropical dry habitats in central and northern Mexico, the Big Bend area of Texas, and southwestern New Mexico and are known to migrate seasonally from Mexico. The Mexican long-nosed bat roosts in caves, abandoned mines, culverts, and hollow trees. Its diet consists primarily of nectar, pollen, and flowers of cacti and agaves (Texas Parks and Wildlife 2023).

Ocelot. The ocelot was listed as endangered under the ESA in 1972. No critical habitat has been designated for this species. These cats prefer a variety of habitats as long as they provide dense cover. The ocelot has been observed in thornscrub, semi-arid vegetation, grasslands, tropical forests, scrub, pine-oak forests, and fir forests (USFWS 2016). Habitat conversion, fragmentation, and loss comprise the primary threats to ocelots. Connectivity among ocelot populations or colonization of new habitats is discouraged by highways as well as development and patrolling of the U.S. border with Mexico.

Jaguar. The jaguar was listed as endangered under the ESA in 1997. Jaguars' broad range of habitat types includes swampy savannas, mountainous desert regions, and dry forests (USFWS 2024a). They are known to occur in arid areas in the southwestern U.S. Currently, jaguars range from southwestern U.S. (primarily south-central Arizona and extreme southwestern New Mexico) to northern Argentina (USFWS 2012a). Critical habitat for the jaguar was originally proposed in 2012 and was updated in 2021. This critical habitat is located south of Tucson in southern Arizona, with the majority of the critical habitat being located in the Coronado National Forest (USFWS 2024a).

Yellow-billed Cuckoo. The western distinct population segment of the yellow-billed cuckoo was listed as federally threatened in 2014. The yellow-billed cuckoo utilizes wooded habitat that supplies dense cover and has a water source nearby. This includes woodlands with scrubby vegetation and dense thickets along marshes and streams (USFWS 2024b). This species is found throughout the western U.S. including Arizona, California, Colorado, Idaho, Montana, Nevada, New Mexico, Oregon, Texas, Utah, Washington, and Wyoming. In the west, the decline of the yellow-billed cuckoo has been attributed primarily to conversion of riparian habitat to farmland and housing (USFWS 2019). Critical habitat for this species is found throughout its range. In Arizona, yellow-billed cuckoo critical habitat is located in riverine habitat in the Coronado National Forest, as well as in the Buenos Aires National Wildlife Refuge and in the San Pedro Riparian National Conservation Area and follows the San Pedro River north (USFWS 2024b).

Southwestern Willow Flycatcher. The southwestern willow flycatcher was listed as federally endangered in 1995. The southwestern willow flycatcher is known to breed in riparian areas in southern California, southern Nevada, southern Utah, southern Colorado, Arizona, New Mexico, western Texas, and extreme northwestern Mexico. They nest within the southwestern U.S. from May to September. The southwestern willow flycatcher breeds in areas near sea level to over 8,500 feet in riparian vegetation alongside rivers, streams, or other wetlands (USFWS 2013). Populations have declined primarily due to extensive loss and degradation of breeding habitat from water diversion, groundwater pumping, changes in flood and fire regimes, clearing and controlling of vegetation, livestock grazing, and invasive non-native plants. In addition, brood parasitism by the brown-headed cowbird has led to further decline in populations (USFWS 2002).

Yuma Ridgway's Rail. The Yuma Ridgway's rail was listed as federally endangered in 1967. No critical habitat has been listed under the proposed MOAs. This species is a small chicken-sized waterbird that prefers shallow freshwater marshes dominated by cattail or bulrush. It may be found in eastern California, southern Nevada, and northwestern Arizona. Occurrences within the Proposed Action area would be very rare due to a natural lack of quality habitat.

Masked Bobwhite. The masked bobwhite was listed as endangered in 1973. No critical habitat has been designated for this species. Masked bobwhite basic habitat requirements include native forbs, grasses, and shrubs which provide insects, habitat, and nesting material. Exposure to aerial predators and high temperatures greatly affects habitat selection. This species' range is limited to south central Arizona (USFWS 2023l).

California Least Tern. The California least tern was listed as endangered in 1970. It is the smallest tern in North America and nests on sandy coastlines, barren to sparsely vegetated sandbars along rivers, sand and gravel pits, and lake and reservoir shorelines. The California least tern breeds from approximately April through August in California and some parts of Arizona and Nevada, although individual occurrences and breeding in Arizona are extremely rare (USFWS 2020). The California least tern is primarily endangered due to habitat loss and degradation, and disturbance within their nesting habitat. Occurrences within the Proposed Action area would be very rare due to a natural lack of quality habitat. In 2009, two pairs of least terns, including one banded individual, nested in Glendale, Arizona, and produced one chick. This was the first documented California least tern nesting in Arizona and birds have not been recorded nesting there since (USFWS 2020).

Mexican Spotted Owl. The Mexican spotted owl was listed as threatened in 1993. Critical habitat for the Mexican spotted owl was designated in 2004, comprising approximately 3.5 million hectares on Federal lands in Arizona, Colorado, New Mexico, and Utah. The Mexican spotted owl occurs in forested mountains and canyonlands throughout the southwestern U.S. and Mexico, ranging from Utah, Colorado, Arizona, New Mexico, and western portions of Texas south into Mexico. The Mexican spotted owl was primarily listed due to alteration of habitat from timber management practices. Primary threats currently are from increased risk of stand-replacing wildland fire (USFWS 2012b).

Northern Aplomado Falcon. The northern aplomado falcons that occur in Arizona and New Mexico were designated as an experimental, non-essential population in 2006. It is one of three subspecies of the aplomado falcon and the only subspecies recorded in the U.S. No critical habitat has been designated for this species. The falcon occurs throughout the coastal prairie habitat along the southern Gulf coast of Texas, and in savanna and grassland habitat along both sides of the Texas-Mexico border, southern New Mexico, southeastern Arizona, and Mexico. The causes of decline for this subspecies include widespread shrub encroachment due to fire suppression and overgrazing and agricultural development in grassland habitats. Significant use of pesticides (such as DDT) may also have contributed to the decline of the species in the past (USFWS 2006).

Cactus Ferruginous Pygmy-owl. The cactus ferruginous pygmy-owl was listed as threatened in 2023. Critical habitat was designated for the species in 1999, with a total of approximately 296,240 hectares (731,712 acres) of riverine riparian and upland habitat located in Pima, Cochise, Pinal, and Maricopa counties, Arizona. The cactus ferruginous pygmy-owl, a subspecies of the ferruginous pygmy-owl (*G. brasilianum*), is a small, cryptic owl that is currently found in southern Arizona, southern Texas, and Mexico. Preferred habitat consists of Sonoran desertscrub and semidesert grasslands in Arizona and northern Sonora, thornscrub and dry deciduous forests in southern Sonora south to Michoacán, and Tamaulipan brushland in northeastern Mexico and live oak forest in Texas (USFWS 2021). The owl is imperiled throughout its range by activities that reduce and fragment its habitat such as invasive species, urbanization, agriculture and forest production, and climate change. It has been extirpated from key areas of its historical range in both Arizona and Texas (USFWS 2023).

MBTA and BGEPA

Over 100 species of migratory birds (to include the bald eagle and golden eagle) have the potential to occur beneath the MOAs (AZGFD 2022b–e). Bald eagles and golden eagles could be present beneath all of the MOAs during their breeding seasons, 15 October to 31 August and 1 December through 31 August, respectively (USFWS 2023a–j). Known concentrations of eagles occur at large bodies of water throughout Arizona and New Mexico some of which occur beneath the MOAs/ATCAAs such as San Carlos Lake, San Carlos River, Salt River, Crescent Lake, and Alamo Lake.

Luke AFB and Morris ANGB currently implement seasonal aircraft avoidances of Bald and Golden Eagle nest sites beneath their managed SUA. Known productive eagle nests are avoided by 1,000 feet AGL from 15 December to 15 July. These avoidance areas are assessed annually based on nest productivity and currently affect the Sells and Ruby MOAs, restricted areas associated with BMGR (not a part of this EIS), and several Military Training Routes that overlap with MOAs addressed in this EIS to include Sells, Bagdad, Gladden, and Outlaw MOAs. All existing avoidances would continue under any alternative in this EIS and are communicated to all military pilots using these areas. There are no specific avoidance areas within Tombstone MOA for Bald and Golden Eagles, pilots using this MOA are required to check AHAS the day of their flight to determine areas that need to be avoided for any bird activity.

State Species of Greatest Conservation Need

The AZGFD and NMDGF maintains lists of state species of concern that are referred to as SGCN. Those SGCN mammals and birds with potential to occur on lands below the MOAs can be found in **Appendix L**. Given the nature of the Proposed Action, no impact would be expected to amphibians and reptiles, small mammals (other than bats), fish, invertebrates, or plants.

3.6.3 Environmental Consequences

Determination of the significance of potential impacts to natural resources is based on: (1) the importance (i.e., legal, commercial, recreational, ecological, or scientific) of the resource, (2) the proportion of the resource that would be affected relative to its occurrence in the region, (3) the sensitivity of the resource to proposed activities, and (4) the duration of ecological ramifications. Impacts to natural resources would be significant if species or habitats of special concern would be adversely affected over relatively large areas or disturbances would cause reductions in population size or distribution of a species of special concern. The FAA Order 1050.1F significance threshold for biological resources is defined as: the USFWS or National Marine Fisheries Service 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. None of the impacts of the Proposed Action would cause these effects, thus the impacts to listed species from this Proposed Action would not be significant.

This analysis focuses on wildlife and special-status species that occur or potentially occur beneath the MOAs, which could be impacted by noise from the Proposed Action and alternatives. In addition to the significance threshold defined above, factors to consider for biological resource impacts defined in FAA Order 1050.1F includes whether the Proposed Action would have the potential for:

- A long-term or permanent loss of unlisted plant or wildlife species, i.e., extirpation of the species from a large project area;
- Adverse impacts to special status species (e.g., state species of concern, species proposed for listing, migratory birds, bald and golden eagles) or their habitats;
- Substantial loss, reduction, degradation, disturbance, or fragmentation of native species' habitats or their populations; or

- Adverse impacts on a species' reproductive success rates, natural mortality rates, non-natural mortality (e.g., road kills and hunting), or ability to sustain the minimum population levels required for population maintenance.

Adverse impacts to special status species from noise disturbance is possible with the Proposed Action (bullet number two); thus, the analysis focuses on those impacts. Other factors defined above are not applicable to this Proposed Action. Many animal species use sound to communicate, to detect prey, and avoid predation. Noise can mask communication, cause behavioral changes, interfere with daily cycles, and can cause stress (Bowles 1995a). Increased noise levels reduce the distance and area over which animals can perceive important acoustic signals (Barber et al. 2009). The potential for external noise to mask these important signals is of greater concern for continuous and near continuous noise sources (e.g., compressors, busy highways) than for intermittent brief noise exposures such as military jet overflight. Such secondary effects of noise vary widely with species, environmental variables, as well as the types, durations, and sources of noise (Manci et al. 1988). Primary effects, such as eardrum rupture or temporary and permanent hearing threshold shifts, are unlikely given the intermittent noise levels produced by military aircraft overflights. Most of the effects of noise are mild enough to be undetectable as variables of change in population size or growth (Bowles 1995a).

Other potential impacts associated with noise may include stress and hypertension; behavioral modifications; interference with mating or reproduction; and impaired ability to obtain adequate food, cover, or water. Other environmental variables (e.g., predators, weather, changing prey base, ground-based disturbance) confound the ability to identify the ultimate factor in limiting productivity of a certain nest, area, or region (Smith et al. 1988). Manci et al. (1988) reported reductions in reproductive success in some bird species after exposures to low-altitude overflights (100–750 feet AGL), while a study of raptor response to sonic booms illustrated that raptors showed little response and reactions were not associated with reproductive failure (Ellis 1981). Overall, the literature suggests that species differ in their response to various types, durations, and sources of noise (Manci et al. 1988; Shannon et al. 2016; Bell 1972; Ellis 1981); and that, response of unconfined wildlife and domestic animals to aircraft overflight under most circumstances has minimal biological significance.

Many scientific studies have investigated the effects of aircraft noise on wildlife, and some have focused on wildlife "flight" due to noise. Animal responses to aircraft are influenced by many variables, including size, speed, proximity (both height above the ground and lateral distance), engine noise, color, flight profile, and radiated noise. The type of aircraft (e.g., fixed-wing [jets] versus rotary-wing [helicopters]) and type of flight mission may also produce different levels of disturbance, and thus varying animal responses. Animal responses to sonic booms have been suggested to be similar to responses to thunder and have been shown to be brief with animals returning to normal behavior quickly thereafter (Lynch and Speake 1978). Research has suggested that animals may habituate to sonic booms after successive exposures (Workman et al. 1992).

Consequently, it is difficult to generalize animal responses to noise disturbances across species and more work is needed to determine if noise adversely impacts wildlife. Research into the effects of noise on wildlife often presents conflicting results because of the variety of factors and variables that can affect and/or interfere with the determination of the actual effects that human produced noise is having on any given animal (Radle 2007).

The DAF has conducted many studies that define a startle response as the sequence of events that occurs when an animal is surprised, including behavioral responses (muscular flinching, alerting, and running) and physiological changes (e.g., elevated heart rate) (DAF 1994). The startle is a natural response that helps animals avoid predators. If the behavioral component of the startle is uncontrolled, particularly if the animal runs or jumps without concern for its safety, it is often called a panic. Completely uncontrolled panics are rare in mammals (DAF 1994). Studies on captive pronghorn, elk, and bighorn sheep reactions to sonic boom have illustrated that heart rate increase lasts for only 30 to 90 seconds and does not represent long-term states of high stress (Workman et al. 1992).

Small mammals, fish, invertebrates, reptiles, and amphibians were eliminated from detailed analysis because these groups do not appear to be particularly sensitive to short duration noise exposure, as would occur during overflights within the MOAs (Bowles et al. 1995b; Manci et al. 1998; Morley et al. 2014). When exposed to in-air noise or sonic booms, aquatic species typically at most show a slight startle response. For reptiles and amphibians, instances have been documented of "freezing" (brief cessation of activity), change of calling behavior, or emergence at inappropriate times of year, but most of these studies examined noise exposure over much longer periods of time than would occur for an overflight (Bowles 1995a; Sun and Narins 2005).

Although the concerns listed above have been raised in the literature and examples have been documented, studies of unconfined wildlife and domestic animals to overflight by military jet aircraft at 500 feet AGL or higher have not shown measurable changes in population size or reproductive success at the population level or other significant biological impact (Manci et al. 1988; Bowles 1995a; Dufour 1980).

Aircrews would be required to follow applicable procedures outlined in their installation's BASH Plan. Pilots are also required to check bird conditions in AHAS for the airspace units they plan to use prior to all flights. This system uses several sources of data to determine the risk of bird strikes in nearly real-time in all DAF-managed airspace (see **Section 3.2.2.1**, *Flight Safety,* for details on AHAS). This system would identify the local areas with concentrations of birds and these would be avoided for safety reasons. Adherence to this program has minimized bird-aircraft strikes historically. When safety procedures identify an increased risk, limits are placed on low-altitude flights and some types of training (e.g., multiple approaches, closed pattern work). Furthermore, special briefings are provided to pilots whenever the potential exists for greater bird-strike risks within airspace.

3.6.3.1 Alternative 1 – No Action

Under the No Action Alternative, military aircraft training would continue to occur in all the MOAs as currently charted. A variety of training activities (i.e., various aircraft speeds and maneuvers within high and low altitudes) would continue to occur in the MOAs, and the resulting noise would be spread across a vast area. As demonstrated in **Section 3.4.3.1**, *Noise, Alternative 1*, the subsonic and supersonic noise exposure under the No Action is relatively low in all MOAs. While a single location would not be subjected to regular or continuous high levels of noise, there would be the possibility that a location could be subjected to a low-level overflight and animals beneath such a flight would experience a high level of intermittent noise. As shown in **Section 3.4**, *Noise*, the estimated noise that would be experienced by an animal would be significantly reduced the further away the animal was from the direct aircraft path (see **Tables 3.4-3 through 3.4-5**). Wildlife beneath the MOAs could experience a single low-level overflight with a high peak sound level, but this experience would be very infrequent, and the peak sound level would only occur for 1/8 of a second. As described in **Section 3.6.3**, general impacts to wildlife (to include protected species) associated with noise would be disturbance. While wildlife would be generally exposed to noise under the No Action Alternative, no single location experiences repetitive or continuous noise since aircraft operations occur throughout such a large area. The noise exposure is not at a level that would impact population levels or have other significant biological impacts.

3.6.3.2 Alternative 2 – Proposed Action

Airspace use within the modified MOAs could potentially disturb wildlife residing beneath the existing and proposed airspace. Disturbance could be caused by the visual observation of aircraft, aircraft noise, and the use of chaff and flares. As detailed in **Section 3.4**, *Noise*, the training within the MOAs would contribute insignificant increases to the average acoustic environment in Tombstone A and B, Tombstone Exclusion area, Outlaw, Morenci, Reserve, Sells, Ruby, and Fuzzy MOAs. Reportable increases in noise would occur in Tombstone C, Tombstone Expansion, Jackal Low, Jackal, Bagdad, and Gladden MOAs. However, the average annual DNL throughout the MOAs from all the aircraft operations would range from less than 35 to 59.6 dB DNL (see **Table 3.4-14**). A variety of training activities (i.e., various aircraft speeds and maneuvers within high and low altitudes) would continue to occur in the MOAs; and the resulting noise would be spread across a vast area. As such, the proposed training would not create a consistent, significant noise source in any one location. The noise exposure is not at a level that would impact populations or have other significant biological impacts.

While it would not be expected that a single location would be subjected to regular or continuous high levels of noise, there would be the possibility that a location would be subjected to a low-level overflight and animals beneath such a flight would experience a high level of intermittent noise. As shown in **Section 3.4**, *Noise*, the estimated noise that would be experienced by an animal would be significantly reduced the further away the animal was from the direct aircraft path (see **Tables 3.4-3** through **3.4-5**). In the most extreme scenario, an animal could experience peak noise level as high as 131 dB for 1/8 of a second. This would only occur from an F-16 or F-35 overflight at 100 feet AGL (proposed for the Tombstone MOA only for this alternative) using maximum power with an afterburner passing directly above the animal and is not expected to occur with any sort of regularity or frequency for a given location (refer to **Table 3.4-6**). The majority of operations would occur above 10,000 feet MSL, which would have a peak noise level of 92 dB from an F-35 aircraft or 90 dB from an F-16 using maximum power with an afterburner passing directly above the animal. Acute exposures to noise (i.e., those that are brief and occasional) potentially damage hearing at levels over 140 to 150 dB in the frequency range heard best by humans. Guidelines that protect human hearing apply to many terrestrial mammals because they are based on studies of laboratory animals (Bowles 1995a). Therefore, the proposed low-level overflights are not expected to result in hearing damage to animals since a direct overflight would not result in noise levels over 140 dB.

Since the Proposed Action would include supersonic flight, sonic booms would occur within some MOAs (Tombstone, Jackal, Outlaw, Morenci, Reserve) at a minimum of 5,000 feet AGL. Sonic booms would continue to occur in Bagdad, Gladden, and Sells as they do currently. Exposure to supersonic noise would be relatively the same in these areas. As described in **Section 3.4**, *Noise*, sonic booms would not contribute significantly to the overall noise environment (the largest being less than 55 dBC CDNL within the Sells MOA).

Potential impacts to wildlife and special-status species are described below.

Wildlife

Potential Effects from Aircraft Noise

Animal species differ greatly in their responses to noise and thus the potential impact to animals from aircraft noise would vary. Below is a summary of studies of the effects of aircraft noise on birds and mammals. Based on estimated noise levels, the proposed modifications and use of the MOAs would be expected to have temporary minor impacts in the form of disturbance to wildlife inhabiting land beneath the airspace.

Mammals. Sound levels above 90 dB may impact mammals and may be associated with a number of behaviors such as retreat from the sound source, freezing, or a strong startle response (Manci et al.1988). Early studies of terrestrial mammals showed that noise levels of 120 dBA could damage mammals' ears, and levels of 95 dBA could cause temporary loss of hearing acuity. It has been speculated that repeated aircraft overflight (e.g., surveillance flights along a pipeline) could affect large carnivores by causing changes in home ranges, foraging patterns, and breeding behavior (Dufour 1980). These possible effects have not been borne out in subsequent studies, and Bowles (1995a) indicated that acute exposure to noise only damaged an animals' hearing at levels above 140 dB.

Bell (1972) reviewed reports and studies of animal response to sonic booms. Specific reactions differ according to the species involved, whether the animal is alone or whether the animal has been previously exposed to sonic booms. Trampling, moving, raising the head, stampeding, jumping, and running are among the reactions reported. Reactions vary from boom to boom and are not predictable, but animal reactions to booms were found to be similar to their reactions to low-altitude subsonic airplane flights, helicopters, and sudden noises (Bell 1972).

Wild ungulates appear to be much more sensitive to noise disturbance than domestic livestock (Manci et al. 1988). Behavioral reactions may be related to the history of disturbances by such things as humans and aircraft. Minor behavioral reactions would include turning to orient toward the aircraft. Moderate responses to disturbance may be nervous behaviors, such as trotting a short distance. Escape behavior would represent a typical severe response, but it is rarely observed in response to overflights above 500 feet AGL (Bowles 1995a; Dufour 1980). In a number of studies of the endangered Sonoran pronghorn, behaviors were observed to be similar with and without anthropogenic stimuli with some minor change in activity during rotary-wing or multiple aircraft overflights. Animals quickly returned to activities and the temporary change in behavior was not detrimental (Krausman et al. 2004; Krausman and Harris 2002).

Although few studies have been conducted on the response of wild ungulates to sonic booms, these disturbances appear to have little to no adverse effects. Workman et al. (1992) studied the physiological and behavioral responses of captive pronghorn, elk, and bighorn sheep to sonic booms. All three species exhibited an increase in heart rate that lasted for 30 to 90 seconds in response to their first exposure to a sonic boom. Behaviorally, the animals responded to their first exposure to a sonic boom by running a short distance (less than 30 feet reported for elk). After successive sonic booms, the heart rate response decreased greatly and the animals remained alert, but did not run. The authors suggested the animals became habituated in response to successive exposures (Workman et al. 1992).

Bat responses to aircraft noise could be similar to responses described for other mammals and would likely include startle or alerting to the noise source (Dufour 1980). Studies of the effects of noise on bats have not documented any behavioral responses to jet or other noise, including during hibernation (Dalton and Dalton 1993 and 3D/Environmental 1996, as cited in Delaney 2002). Another concern for bat species would be masking of echolocation pulses that could disrupt flight or foraging. A study on New Zealand long-tailed bats found that low-level aircraft activity did not mask echolocation pulses since the aircraft noise was most intense at less than 10 kilohertz (kHz); and, bat echolocation pulses are 40 kHz. There were no statistically significant differences in mean bat activity during and after overflights compared with pre-aircraft activity (Le Roux and Waas 2012). The percent of sorties that occur during the daytime and nighttime would not change under the Proposed Action, and thus, would have no change to impacts on foraging bats.

Birds. In comparison to humans, birds typically hear less well over a narrower frequency bandwidth (Dooling and Popper 2007). The majority of the published literature on bird hearing focuses on terrestrial birds and their ability to hear in air. A review of 32 terrestrial and marine species reveals that birds generally have greatest hearing sensitivity between 1 and 4 kHz, and very few can hear below 20 Hertz (Hz) (Beason 2004). Most concerns related to the effects of noise on birds involve the masking of communications among members of the same species, reducing the detectability of biologically relevant signals including the sounds of predators and prey, and temporarily or permanently decreasing hearing sensitivity (Dooling and Popper 2007). A study of captive zebra finches given a choice of foraging in noisy and quiet areas found no significant difference in the amount of time birds spent in noisy and quiet areas though those foraging in noisy areas spent more time being vigilant, resulting in less efficient foraging than those in quiet areas (Evans et al. 2018). In a study of ovenbirds, Habib et al. (2007) found chronic noise exposure near compressor stations affected pairing success, attributable to masking and distorting the song of breeding males on territories. In birds, hearing loss is difficult to characterize since birds regenerate hair cells even after substantial losses that can result in temporary threshold shifts (Bowles 1995a).

In a literature review of raptor responses to aircraft noise, Manci et al. (1988) found that most raptors did not show a negative response to overflights. When negative responses were observed, they were predominantly associated with rotor-winged aircraft or jet aircraft that were repeatedly passing within 0.5 mile of a nest. Ellis et al. (1991) performed a study to estimate the effects of low-level military jet aircraft and mid- to high-altitude sonic booms (both actual and simulated) on nesting peregrine falcons and seven other raptors (common black hawk, Harris' hawk, zone-tailed hawk, red-tailed hawk, golden eagle, prairie falcon, and bald eagle). Re-occupancy and productivity rates were within or above expected values for self-sustaining populations. In a 1997 helicopter overflight study, Mexican spotted owls did not flush from a nest or perch unless a helicopter was as close as 330 feet (Delaney et al. 1999). Researchers in Colorado found that Mexican spotted owl responses to F-16 overflights were often less significant than responses to naturally occurring events such as thunderstorms. Similarly, Delaney et al. (1999) found that Mexican spotted owls quickly returned to normal day-roosting behavior after being disturbed by helicopters. A 6-year study within the Gila National Forest found that low-level aircraft overflight had no effect on occupancy of Mexican spotted owl activity centers and found no correlations among measures of aircraft exposure and nesting success (ACC 2008).

Manci et al. (1988) noted that aircraft can be particularly disturbing to waterfowl. The USFWS Waterfowl Management Handbook (Korschgen and Dahlgren 1992) lists "loud noise" caused by aircraft as the top disturbance category for waterfowl. Several studies showed that migratory waterfowl (e.g., ducks and geese) expend more energy when exposed to repeated aircraft overflights, at least in the short term (Bowles 1995a). Waterfowl are sensitive to disturbance because of their aggregation into large flocks during their migration and overwintering. In the study area, concentrations of waterfowl would be present during seasonal migrations along the Pacific Flyway, where they would stop over to feed and rest in large waterbodies. When at rest, the flocks are typically in water bodies or wetlands exposed to the open sky and subject to aerial and ground predation. Taking flight is their defense against either type of predation. Waterfowl flocks seem to be as sensitive as their most responsive individual in the flock, so that larger flocks would have a greater chance of responding than small flocks (Bowles 1995a).

Birds occasionally run, fly, or crowd in the presence of a sonic boom (Bell 1972). Bell (1972) also examined the effects of booms on eggs hatched under commercial conditions, and no effects on hatching success were found. Teer and Truett (1973) conducted a study near Glen Rose, Texas, to determine if occurrence of sonic booms created by overflying aircraft were adversely affecting reproduction of wild birds. The examination area was subject to sonic booms occurring two or three times a week and the control area was essentially free from sonic boom disturbance. In the final analysis, there was no evidence found that sonic boom disturbance affected phases of bird reproduction and the pressures had no effects on hatching success, growth rates, or mortality (Teer and Truett 1973).

A variety of studies cited in Bowles (1995a) indicated that migratory waterfowl exposed to overflights by light aircraft and helicopters did not habituate completely to overflight. Due to the danger to aircraft and aircrews posed by potential collisions with waterfowl and other flocking birds, BASH has received much attention by the military. BASH programs exist at every installation where there is an active flying mission and areas where low-level aircraft flight training takes place. BASH programs identify locations of seasonal concentrations of waterfowl and provide guidance for pilots with regard to elevational or lateral separation from these sites at specific seasons and times of day to avoid or minimize the potential for collision. Pilots are also required to review AHAS for any airspace unit they plan to use. This avoidance in turn reduces the potential for disturbance of migratory waterfowl concentrations by military aircraft overflight. See **Section 3.3,** *Safety*, for additional discussion on BASH with respect to safety concerns and a description of AHAS.

Small mammals, fish, amphibians, reptiles, and invertebrates. The effects of overflight aircraft noise on small mammals, reptiles, fish, amphibians, and invertebrates have not been well documented, but conclusions on their expected responses have involved speculation based upon known physiologies and behavioral traits of these taxa (Gladwin et al. 1988; Manci et al. 1988). Studies summarized in Manci et al. (1988) suggest that fish have not been found to be sensitive to in-air noise or sonic booms, showing at most a slight startle response. Although studies of longer periods of noise exposure have documented effects on invertebrate behavior and reproductive success, brief, intermittent noise exposure did not appear to negatively affect the invertebrate species studied. The few studies on noise impacts to reptiles and amphibians examined noise exposure over much longer periods of time than would occur for an overflight. Short-term behavioral responses in reptiles and amphibians have included freezing and emergence at inappropriate times, but it is unclear if these were due more to vibrations or the noise itself (Bowles 1995a). During and after an overflight, frogs may remain 'frozen' for a brief period and may temporarily cease breeding calls. If frogs do not freeze, overflight noise may mask breeding calls for about 1- to 2-minutes. If overflight noise/vibrations prompt emergences during the dry season, species that use auditory cues (i.e., thunder) to emerge from burrows may deplete energy reserves and become dehydrated. A study from 2005 concluded that certain species of acoustically active, pond-dwelling frogs decrease their call rate when exposed to airplane flyby or motorcycle engine playbacks. However, another species increased calling under the same acoustic conditions. These findings suggest that frogs change their calling behavior to avoid acoustic masking and frog communities' vocalizations may be temporarily altered by anthropogenic noises (Sun and Narins 2005). However, data does not suggest that this causes harm to frog populations (Sun and Narins 2005).

A study was conducted from 1991 to 1994 evaluating the effects of low-altitude aircraft overflights on small mammals, specifically heteromyid rodents, within the BMGR (Bowles et al. 1995b). The results of this study indicated that many of the small mammal species within the study area spent the day in burrows or dens, which was thought to protect them from aircraft noise. However, the A-weighted sound exposure level in the burrows averaged less than 3 dB lower than at 1.2 meters above the surface, so the burrows only provided a slight buffer from the noise. Significant attenuation was seen only above 1300 Hz, and heteromyid rodents are able to hear well down to 100 Hz and were therefore likely to hear the aircraft sounds in their burrows (Bowles et al. 1995b). Although the data suggested that the aircraft noise reached the small mammals in their burrows, no significant differences in small mammal species diversity, population numbers, and animal weights were found between the sound-exposed areas and control areas not exposed to sound. This suggests that the small rodents' populations were not affected by aircraft noise.

Additionally, many species of small mammals are nocturnal and/or hibernate. The New Mexico meadow jumping mouse is mostly nocturnal, which may limit noise exposure during waking hours, and hibernates about 9 months out of the year (USFWS 2023m). Noise impacts to the red squirrel are expected to be similar to those associated with other small terrestrial mammals. Frequency of vocalization by red squirrels ranges from 0.5 kHz to 6.5 kHz, and alarm calls, which are given when they feel threatened by potential predators or intruders, typically have frequencies ranging from 1–2 kHz (Smith 1978). With aircraft noise present, red squirrels may decide to select quiet habitat areas that minimize the influence of noise detection of predators and availability to hear alarm calls. Yet, effects of anthropogenic noise on predation risk and territorial defenses have not been demonstrated (Francis and Barber 2013).

Research on invertebrates' reactions to anthropogenic noise suggest that behavior plasticity is a likely response to anthropogenic noise (Morley et al. 2014). Hearing ranges vary greatly depending on invertebrate orders; therefore, different orders or species are likely to react differently to a noise (Morley et al. 2014). Numerous studies have shown that insects adjust their auditory expressions around anthropogenic sound (Morely et al. 2014). Because aircraft noise from this project would be intermittent, invertebrates on or near the ground are likely to briefly pause or adjust calling, and may experience brief masking of auditory cues from other individuals, but this noise is unlikely to represent significant negative effects to invertebrate populations.

In conclusion, the available data on effects of temporary aircraft noise to fish, amphibians, reptiles, invertebrates, and small mammals does not suggest that this type of noise stimulus would result in significant negative effects to these species. Brief overflight aircraft noise may result in short-term behavioral responses in some species of these organism groups, but data largely suggests that these groups experience little harmful effect from aircraft noise and therefore these species are considered to experience no effect from the Proposed Action.

Potential Effects from Chaff and Flare Use

No toxicological effects from chaff or flares on terrestrial organisms have been observed, even when subject to higher concentrations than would occur under the Proposed Action (DAF 2011). Residual materials would be distributed over a large area and would degrade over time. See **Appendix F** for a detailed discussion of chaff and flare components and studies. No effects to wildlife from chaff and flare use are expected to occur.

The possibility of a wildfire from flare usage impacting wildlife habitat would be remote considering the release altitude under the Proposed Action. Flares would not be released below 2,000 feet AGL and are designed to burn completely within the first 400 feet of descent. The risk of wildfires from flare usage would be mitigated by operational constraints established by the respective Wing Commanders as a measure to ensure safe operation and protection of the public. Potential impacts associated with wildfires is further discussed in **Section 3.3**, *Safety*.

Domestic Animals

Potential Effects from Aircraft Noise

Behavioral reactions to jet aircraft noise in domestic animals vary with each species; however, observations of livestock exposed to sonic booms have generally consisted of startle reactions that were considered minimal (Manci et al. 1988). In a study of the effects to the anatomy of swine ears from aircraft noise, animals exposed to trials of aircraft noise of 120 dB to 135 dB showed no injury to the gross anatomy of the ear or the organ of corti compared to a control group (Dufour 1980). In another study, nursing sows, baby pigs, and adult pigs during mating were observed to show initial alarm followed by indifference at noise sources from 104 to 120 dB (Dufour 1980). These researchers considered that swine were able to tolerate and even become accustomed to noise up to at least 120 dB (Dufour 1980). It is expected that domestic animals and livestock beneath the proposed airspace would have a behavioral reaction to an overflight but the intensity of that reaction would vary greatly with the species and other environmental conditions at the time of the overflight. These studies indicate that these animals would habituate to the noise over time if it occurred with some regularity and such noise would not have a long-term impact. Animals experiencing an overflight for the first time would likely alert or startle, but it is not expected that this would have a detrimental impact to the animal's overall health. Given the volume of proposed airspace, no single location is expected to be subjected to repeated or continuous low-level overflights or sonic booms (see **Table 3.4-6**).

Horses have a wide auditory range of approximately 55Hz–33.3kHz and have the ability to detect low frequency sound better than many mammals including primates (Heffner and Heffner 1983). As compared to humans, horses are able to detect higher frequency sound than human and humans can detect lower frequency sounds than horses. As prey species, horses evolved to identify predators by sound and typically respond with freezing followed by erratic movements or "flight" response (Hole et al. 2023). Horses have been observed to show fright responses, such as jumping or galloping around, to jet aircraft (Dufour 1980). Horses can often habituate or become used to a noise, but this varies greatly depending on the individual horse's temperament and training. Their reaction is usually strongest when the noise resembles that of a predator, that is, a quiet rustling would elicit a stronger response than a high-speed train (The British Horse Society, no date).

While the studies on the effect of aircraft noise on pregnant mares are somewhat limited, LeBlanc et al. performed a study that focused on changes in pregnancy success, behavior, cardiac function, hormonal production, and rate of habituation in response to F-14 overflights (LeBlanc et al. 1991). The study found that pregnant mares habituated to jet noise after a few exposures. All of the mares showed flight posture after the first noise exposure but at no time did any of them strike or run into stall walls. Since the mares in this study were kept in stalls during the noise exposure events, it was speculated that in a large, open environment the response would have been stronger (galloping farther distance or faster). There were no differences in pregnancy success when compared to a control group. Since all of the mares habituated to the noise, it was recommended that new mares remain in familiar stalls until their reaction to overflights could be gauged and they become habituated (LeBlanc et al. 1991). Since the overflights associated with the Proposed Action are not expected to occur with regularity at any one location, any pregnant mares that happen to be beneath the flight path of a low-level flight would likely startle but their reaction is not anticipated to result in pregnancy loss.

Horseback riding is a common practice beneath the existing and proposed airspace. The primary concern with respect to horses would be the safety of the rider or handler in the event a horse startles and bolts to such a degree that the rider is thrown from the horse or the horse injures itself. While it is possible that a horseback rider may experience an overflight, it is not expected that this would be a regular situation given the volume of airspace proposed for training. It is assumed that a horse would startle and possibly spin or bolt in response to an overflight, although the response would vary greatly with each individual animal. In support of the Report to Congress: Potential Impacts of Aircraft Overflights of National Forest Service System Wildernesses, a review of USFS annual reports for a 10-year period found three accidents were reported in which aircraft startled the horse and threw the rider (USFS 1992). Also in this study, national visitor surveys about accidents found that 1,180 visits reported an "accident," but none of those accidents were related to aircraft overflights. These survey results indicate that while there is potential for aircraft to cause accidents (to include startling horses), incidents are rare.

In addition to the proposed military aircraft overflights, aircraft are used for a variety of forest management objectives such as fire suppression, resource management, and scenic overflights; therefore, the presence of aircraft is not uncommon. The proposed modifications and use of the MOAs would be expected to have temporary minor impacts to domestic animals inhabiting land beneath the airspace.

Potential Effects from Chaff and Flare

A 1972 study found no evidence of toxicity in calves fed chaff (DAF 2011). The study was unsuccessful in getting calves to eat chaff until the chaff was soaked with molasses. The study found no significant differences in the weight gain of calves given chaff versus the animals not given chaff. Similar studies in cattle and goats found no evidence that chaff ingestion posed a health hazard for farm animals (DAF 1997). Since chaff distribution is expected to be very minor in any given location, adverse effects from chaff ingestion is not expected. Another concern of chaff that has been raised would be its effect on sheep's wool. In the unlikely event that chaff or residual materials had fallen on a sheep and remained in the wool, it is expected these items would be removed from the wool during the normal process to remove impurities prior to marketing the wool (DAF 2011). The potential effects of flares and flare residual materials to domestic animals would be the same as those described for wildlife.

Special-Status Species

The potential impacts associated with the proposed training activities to special-status species, including those listed by the states of Arizona and New Mexico, would be the same as those described in the wildlife section above. As described above in *Potential Effects from Chaff and Flare*, there have been no observed effect of chaff on terrestrial organisms, even when subject to higher concentrations than would occur under the Proposed Action. Birds have not been documented using chaff filaments or residual materials as nesting material or food. The possibility of a wildfire from flare usage would be remote considering the reliability of flares, the proposed release altitude, and the fire restrictions that are currently used in all the MOAs. Therefore, the use of chaff and flares would not affect threatened or endangered species.

The Proposed Action may result in the "take" of migratory birds; however, the Proposed Action is a military readiness activity; therefore, "take" is in compliance with the MBTA. Under the MBTA, regulations applicable to military readiness activities (50 CFR Part 21), the USFWS has promulgated a rule that authorizes the incidental take of migratory birds provided they do not result in a significant adverse effect on a population of a migratory species. The proposed training would not result in a significant adverse impact on any population of a migratory bird species. As stated previously, adherence to BASH procedures and utilization of AHAS greatly reduces the risk of striking migratory birds during military training.

Impacts to Bald and Golden Eagles would be as described above (**Section 3.6.3.2,** *Wildlife*) for raptors, which generally do not show negative responses to fixed-wing aircraft overflights and have not been shown to affect breeding success or habitat occupancy; therefore, no take is anticipated (Manci et al. 1988; Ellis et al. 1991; Delaney et al. 1999; ACC 2008). Existing seasonal Bald and Golden Eagle nest avoidances throughout SUA in Arizona would continue with implementation of the Proposed Action.

Critical habitat has been designated for five federally listed species potentially affected by the Proposed Action (southwestern willow flycatcher, Cactus Ferruginous Pygmy-owl, yellow-billed cuckoo, Mexican spotted owl, and jaguar). The Proposed Action would not alter or otherwise affect critical habitat beneath the airspace. As described in previous sections of this EIS, chaff filaments and residual materials from chaff and flare use would not be concentrated in any one area to a degree that would have an impact to ground or water resources. The Proposed Action does not include any ground-disturbing activities that would remove critical habitat or diminish its availability or quality. The potential for an occasional overflight at various altitudes would not affect the quality of the habitat. Therefore, the Proposed Action would have no effect on critical habitat.

The potential impact to federally listed species would be disturbance from aircraft noise (both subsonic and supersonic). The federally listed bird and mammal species that potentially occur beneath the MOAs would not be expected to be significantly affected by the noise associated with the Proposed Action. In accordance with Section 7 of the ESA, the DAF is consulting with USFWS and this consultation will be complete prior to the Final EIS. A summary of the potential impacts from aircraft noise is provided below for each federally protected species.

Sonoran pronghorn. Sonoran pronghorn has the potential to occur beneath the Sells, Ruby, and Fuzzy MOAs. Ungulate reactions to aircraft overflights and noise are typically minor behavioral reactions. In a number of studies of the endangered Sonoran pronghorn, behaviors were observed to be similar with and without anthropogenic stimuli with some minor change in activity during rotary-wing or multiple aircraft overflights. Animals quickly returned to activities and the temporary change in behavior was not detrimental (Krausman et al. 2004; Krausman and Harris 2002). Moderate responses to disturbance may be nervous behaviors, such as trotting a short distance. Escape behavior would represent a typical severe response, but it is rarely observed in response to overflights above 500 feet AGL (Bowles 1995a; Dufour 1980). There are no vertical or horizontal changes for the Sells, Ruby, or Fuzzy MOAs and the noise exposure in these areas would be relatively unchanged. The minor increase in DNL is attributed to the 10 percent increase in sorties applied to the noise analysis to account for fluctuation in use year to year. Individuals would continue to be exposed to low-level aircraft overflights and sonic booms, but any behavioral impacts would be brief and minor. The Proposed Action would not jeopardize the continued existence of the Sonoran pronghorn.

Mexican wolf. While wolves have been frightened by low-altitude flights that were 25 to 1,000 feet AGL, they have been found to adapt to aircraft overflights and noise as long as they were not being hunted from aircraft (Dufour 1980). Incidental observations of wolves and bears exposed to fixed-wing aircraft and helicopters indicated a stronger reaction to helicopters. Wolves were less disturbed by helicopters than other large mammals such as wild ungulates, while individual grizzly bears showed the greatest response of any animal species observed (Manci et al. 1988). Fright is not a recognized cause of abortions in clinical studies involving thousands of animals. Spontaneous noise-induced abortions do not occur in well-established pregnancies (Bowles 1995a). If a noise arouses an animal (i.e., gets their attention, wakes them, or increases their activity), the increased activity has the potential to affect the animals' metabolic rate. The increased activity could deplete energetic reserves. A few studies have documented increases in activity after aircraft approaches, but the response was fairly mild, such as starting a few steps or walking away slowly from the site of the disturbance (Bowles 1995a). Given the available information, the potential impact to the Mexican wolf from the proposed operations would be temporary and minor. The Proposed Action is not likely to jeopardize the continued existence of the Mexican wolf.

Mexican long-nosed bat. Bat responses to overflights would be the same as those described for other mammals. Startle or fright is typically the immediate behavioral reaction to transient, unexpected noise in mammals (Dufour 1980). A field study was conducted to determine if aircraft noise altered the evening activity of New Zealand long-tailed bats (Le Roux and Waas 2012). In this study the low-altitude aircraft activity overlapped the evening bat activity near a runway at an international airport. The study found that the aircraft activity did not mask echolocation pulses since the aircraft noise was most intense at less than 10 kHz and bat echolocation pulses are 40 kHz (Le Roux and Waas 2012). Given the limited potential interaction with overflights because of their nocturnal nature, it is expected that noise disturbance to the bat would be minor and temporary. The Proposed Action may affect, but is not likely to adversely affect the Mexican long-nosed bat.

Ocelot and Jaguar. Potential impacts from noise on ocelots and jaguars is not known but would likely be similar to those described for wolves. There are no studies or data on ocelot or jaguar responses to jet overflights. Both species have the potential to occur beneath airspace with proposed floor of 100 feet AGL (Tombstone MOA). Though both species are rare and therefore the potential for exposure to overflights is low, the proposed overflights could disturb any individuals overflown. Therefore, the Proposed Action may affect, but is not likely to adversely affect ocelots and jaguars.

Yellow-billed Cuckoo and Southwestern Willow Flycatcher. Though there are no studies of the effects of noise on these species, the potential impacts from aircraft noise are expected to be the same as those described above for birds: masking of intraspecific communications, reduced detectability of predators, and with exposure to high noise levels, temporary hearing shifts. Noise disturbance, particularly from recreationists, is listed among the threats to the southwestern willow flycatcher and is often accompanied by other impacts such as vegetation damage and removal, increased incidence of fire, increased spread of invasive plant species, increases in predation, and disturbance from vibrations from low-frequency noise (USFWS 2002). The same potential for disturbance applies to yellow-billed cuckoo, which also breed in riparian habitat where recreation is common. As noted in *Wildlife*, birds occasionally run, fly, or crowd in the presence of a sonic boom (Bell 1972). Bell (1972) also determined sonic booms had no effect on hatching success. Teer and Truett (1973) found no evidence that sonic boom disturbance affected phases of bird reproduction and the pressures had no effects on hatching success, growth rates, or mortality (Teer and Truett 1973).

Though increases in noise are expected to occur as a result of the Proposed Action in parts of the lands beneath the MOAs, noise levels would remain generally low and exposure would be distributed over a large area and episodic rather than chronic. Any masking that would occur would be temporary and minor and is not expected to result in impacts to breeding success of these species. Based on the nature of the noise that would result from the modification of the MOAs, and the low likelihood of a direct overflight, the potential for impacts to these species would be low. In the event a direct overflight did occur, impacts are expected to be temporary and minor. The Proposed Action may affect, but is not likely to adversely affect the southwestern willow flycatcher or yellow-billed cuckoo.

Yuma Ridgway's Rail. Although individual Yuma Ridgway's rails could experience minor and temporary noise exposure as described above, their sporadic occurrence due to freshwater marsh habitat requirements would drastically reduce the potential for individuals or populations to be exposed to aircraft noise. The Proposed Action may affect, but is not likely to adversely affect the species.

Masked Bobwhite. Potential noise impacts to masked bobwhite would be similar to those described for yellow-billed cuckoo and southwestern willow flycatcher. Individuals could experience minor and temporary noise exposure as described above. The Proposed Action may affect, but is not likely to adversely affect the masked bobwhite.

California Least Tern. The occurrence of California least terns in Arizona is so rare (two historic nests [USFWS 2020]), that the potential for an individual to be impacted by noise from the Proposed Action is negligible. The Proposed Action may affect, but is not likely to adversely affect the California least tern.

Mexican Spotted Owl. The Mexican spotted owl could occur in forested areas beneath most of the MOAs and thus owls could experience low-level overflights. In a 1997 helicopter overflight study, Mexican spotted owls did not flush from a nest or perch unless a helicopter was as close as 330 feet (Delaney et al. 1999). Researchers in Colorado found that Mexican spotted owl responses to F-16 overflights were often less significant than responses to naturally occurring events such as thunderstorms. Similarly, Delaney et al. (1999) found that Mexican spotted owls quickly returned to normal day-roosting behavior after being disturbed by helicopters. A 6-year study within the Gila

National Forest found that low-level military aircraft overflight had no effect on occupancy of Mexican spotted owl activity centers and found no correlations among measures of aircraft exposure and nesting success (ACC 2008). Movement and flight as a behavioral response to overflights has been treated as a potential concern since it exposes the owl, chicks, or eggs to predation. However, the results of the 6-year study showed that Mexican spotted owl flights in response to military jet overflights were so rare that the rate could not be distinguished from normal rates of flight. In fact, females were never observed flushing from nests in response to military jets or other low-flying aircraft. Observations during this study confirmed that flight and flushing responses are close-range defensive responses (ACC 2008). Given these studies, Mexican spotted owls beneath the MOAs could be disturbed from low-level training activity, but the impact would be temporary and minor. The Proposed Action may affect, but is not likely to adversely affect the Mexican spotted owl.

Cactus Ferruginous Pygmy-owl. Potential noise impacts to the cactus ferruginous pygmy-owl would be similar to those described for the Mexican spotted owl. Cactus ferruginous pygmy-owls occur in riparian and upland habitat beneath the Fuzzy, Jackal, Outlaw, Ruby, and Sells MOAs. Although owls are 15–20 dB more sensitive in their best range than other birds, studies on the Mexican spotted owl show minimal response to aircraft noise. Individuals could experience minor and temporary noise exposure as described for the Mexican spotted owl. The Proposed Action may affect, but is not likely to adversely affect the Cactus ferruginous pygmy-owl.

Northern Aplomado Falcon. In a literature review of raptor responses to aircraft noise, Manci et al. (1988) found that most raptors did not show a negative response to overflights. When negative responses were observed, they were predominantly associated with rotor-winged aircraft or jet aircraft that were repeatedly passing within 0.5 mile of a nest. Ellis et al. (1991) performed a study to estimate the effects of low-level military jet aircraft and mid- to high-altitude sonic booms (both actual and simulated) on nesting peregrine falcons and seven other raptors (common black hawk, Harris' hawk, zone-tailed hawk, red-tailed hawk, golden eagle, prairie falcon, bald eagle). Re-occupancy and productivity rates were within or above expected values for self-sustaining populations. Based on these studies, the potential impact to any falcons occurring beneath the MOAs would be temporary and minor. The Proposed Action would not jeopardize the continued existence of the Northern Aplomado Falcon.

3.6.3.3 Alternative 3

Alternative 3 includes similar geographic locations (and associated wildlife) as Alternative 2, but the northern expansion of approximately 10 nautical miles of Tombstone MOA would not occur, so impacts to species would occur on a lesser geographic scale. Also of note is the floors of both Tombstone and Jackal would be lowered to 100 feet AGL, exposing land beneath Jackal to more noise than in other alternatives. Overall, there would be slight increases to the average acoustic environment, ranging from less than 35 to 59.6 dB DNL, including insignificant but reportable increases beneath parts of Tombstone C, Jackal, and Gladden/Bagdad MOAs (see **Table 3.4-19**). The potential impacts to wildlife and special-status species associated with aircraft noise and chaff and flare usage would be the same as described for Alternative 2.

3.6.3.4 Alternative 4

Alternative 4 would have the same proposed changes as Alternative 2, except that supersonic flight would be authorized down to 10,000 feet AGL (instead of 5,000 feet AGL) in Tombstone, Outlaw, Jackal, Morenci, and Reserve MOAs, which would slightly reduce supersonic noise in these areas from that presented in Alternative 2. Proposed sorties and chaff and flare usage would remain the same. Therefore, impacts to wildlife and special-status species would be the same as described for under Alternative 2, except that the potential intensity of individual sonic booms in the Tombstone, Outlaw, Jackal, Morenci, and Reserve MOAs would be less.

3.6.4 Cumulative Impacts

The training proposed by all alternatives could potentially disturb wildlife and special-status species inhabiting areas beneath the airspace. Because the Proposed Action and alternatives involve changes to airspace and no ground-disturbing activities, potential disturbance to animal species resulting from noise and visual observation of aircraft were evaluated. No effects from chaff or flares would be anticipated. The proposed training would contribute only insignificant increases to the average acoustic environment and would not create a consistent, significant noise source in any location. The analyses in other past and future actions indicated a similar minor impact to natural resources. Post implementation noise levels for this Proposed Action, which would range from less than 35 to 59.6 dB DNL, account for existing use of the MOAs and potential transient activity; and so, direct and indirect effects described in Chapter 4 would be inclusive of ongoing and reasonably foreseeable training actions described in **Appendix G**. As with current operations, there would be the possibility that a location would be subjected to a low-level overflight and animals beneath such a flight would experience a sudden onset of high-level noise.

Aside from aircraft operations, wildlife and special-status species beneath the proposed MOAs are subject to both land management activities and conservation efforts on Federal lands managed by NPS, BLM, and USFS, which contribute positively and negatively to the overall effects to species. U.S. Customs and Border Protection activities on the U.S.-Mexico border and transmission line development could negatively affect natural resources by removing habitat, hindering movements of animals, introducing noise, vehicular, and other human disturbance. The Customs Border Patrol border wall along the U.S.-Mexico border and other border security enhancements are likely to contribute to cumulative effects to natural resources and especially wildlife species. The border wall is intended to deter disturbance from human border crossing activity; however, it also serves as an obstacle to wildlife movement and migration, which is essential to population health of animals that live throughout the American southwest and northern Mexico. Therefore, the border wall has a high likelihood of impact to natural resources, most specifically wildlife, and very likely contributes to negative cumulative effects. The Proposed Action is expected to have minor disturbance to wildlife and would not be expected to result in significant cumulative impacts to natural resources.

3.6.5 Mitigations

There are no significant impacts to natural resources. Mitigations for "may affect, not likely to adversely affect" impacts to federally threatened and endangered species, if required, will be developed through ESA Section 7 consultation with USFWS. That consultation is occurring concurrent to the NEPA process and this EIS will be updated as the consultation progresses. The DAF would continue to coordinate with AZGFD concerning Bald and Golden Eagles in Arizona that are potentially impacted by the Proposed Action that are not currently avoided under a previous agreement.

3.7 LAND MANAGEMENT AND RECREATION

3.7.1 Resource Definition and Regulatory Framework

Land management describes ownership and management of land that lies beneath the airspace affected by the Proposed Action and alternatives and examines any conflicts that may exist between the Proposed Action and land use for the area potentially affected. For this analysis, recreation includes outdoor activities that occur on land that lies beneath the airspace affected by alternatives under the Proposed Action. Potential effects to domestic animals are discussed in **Section 3.6.3**.

The compatibility of existing and planned land use with aviation is usually associated with acoustic environment (noise), which is described in **Section 3.4.** Subsonic noise exposure greater than 65 dB DNL is considered generally incompatible with residential, public use (i.e., schools), or recreational and entertainment areas (FICUN 1980). Similarly, the U.S. Army Public Health Command indicates that supersonic noise less than 62 dBC CDNL is generally compatible with all land uses and noise sensitive areas (U.S. Army Center for Health Promotion and Preventive Medicine 2005). Under the MOAs addressed in this Proposed Action, no person or place would be exposed to noise levels greater than 65 dB DNL or 62 dBC CDNL under any of the alternatives. Therefore, no incompatible land uses, no significant impacts to land uses, and no significant impacts to recreational uses would occur as a result of increases in noise related to the Proposed Action. FAA Order 1050.1F requires that special consideration must be given to the evaluation of noise impacts in areas of quiet setting where compatible land use criteria are not relevant to the value, significance, and enjoyment of the area (e.g., wilderness areas, national wildlife refuge, etc.).

Although there are no significant impacts to land use and recreation resulting from noise under this Proposed Action, for airspace actions, FAA requires that noise analysis identify “reportable changes” (see **Section 3.4**, *Acoustic Environment* and FAA Order 1050.1F for additional information). These are defined as areas where noise will change by:

- For DNL 65 dB and higher: +/- DNL 1.5 dB (significant)
- For DNL 60 dB to <65 dB: +/- DNL 3 dB (reportable)
- For DNL 45 dB to <60 dB: +/- DNL 5 dB (reportable)

The following MOAs would experience increases considered reportable by FAA and thus require further evaluation, specifically for areas of quiet setting: Tombstone C, Tombstone (Proposed Expansion), Jackal, Jackal Low, Outlaw, and Gladden/Bagdad. There are no reportable increases and no noise levels greater than 65 dB DNL or 62 dBC CDNL indicating there would be no compatibility issues to land use or recreation under the following: Tombstone A and B, Tombstone (Exclusion Area), Morenci, Reserve, Sells, Fuzzy, and Ruby MOAs. Thus, further analysis of overall land use and recreation beneath these MOAs is not required.

Wilderness Areas protected by the National Wilderness Preservation System exist beneath all the MOAs. These areas have been designated as such to preserve their natural conditions and are managed by the USFS, NPS, USFWS, and BLM. This section includes an analysis of the potential impacts to all Wilderness Areas.

In accordance with FAA Order 1050.1F, another factor to consider in evaluating significance of impacts to land use also includes impacts preventing a river on the Nationwide Rivers Inventory from being included in the Wild and Scenic River System or causing a downgrade in its classification (e.g., from wild to recreational) through visual, audible, or other intrusions that are out of character with the river or that would alter outstanding features of the river's setting. There are no Wild and Scenic Rivers beneath any of the MOAs; as such, further analysis of Wild and Scenic Rivers is not required. The noise exposure beneath all of the MOAs under any alternative would not exceed 65 dB DNL, a level determined compatible with all land uses to include recreation. Thus, the Proposed Action would not prevent a river on the Nationwide Rivers Inventory from being included in the Wild and Scenic River System.

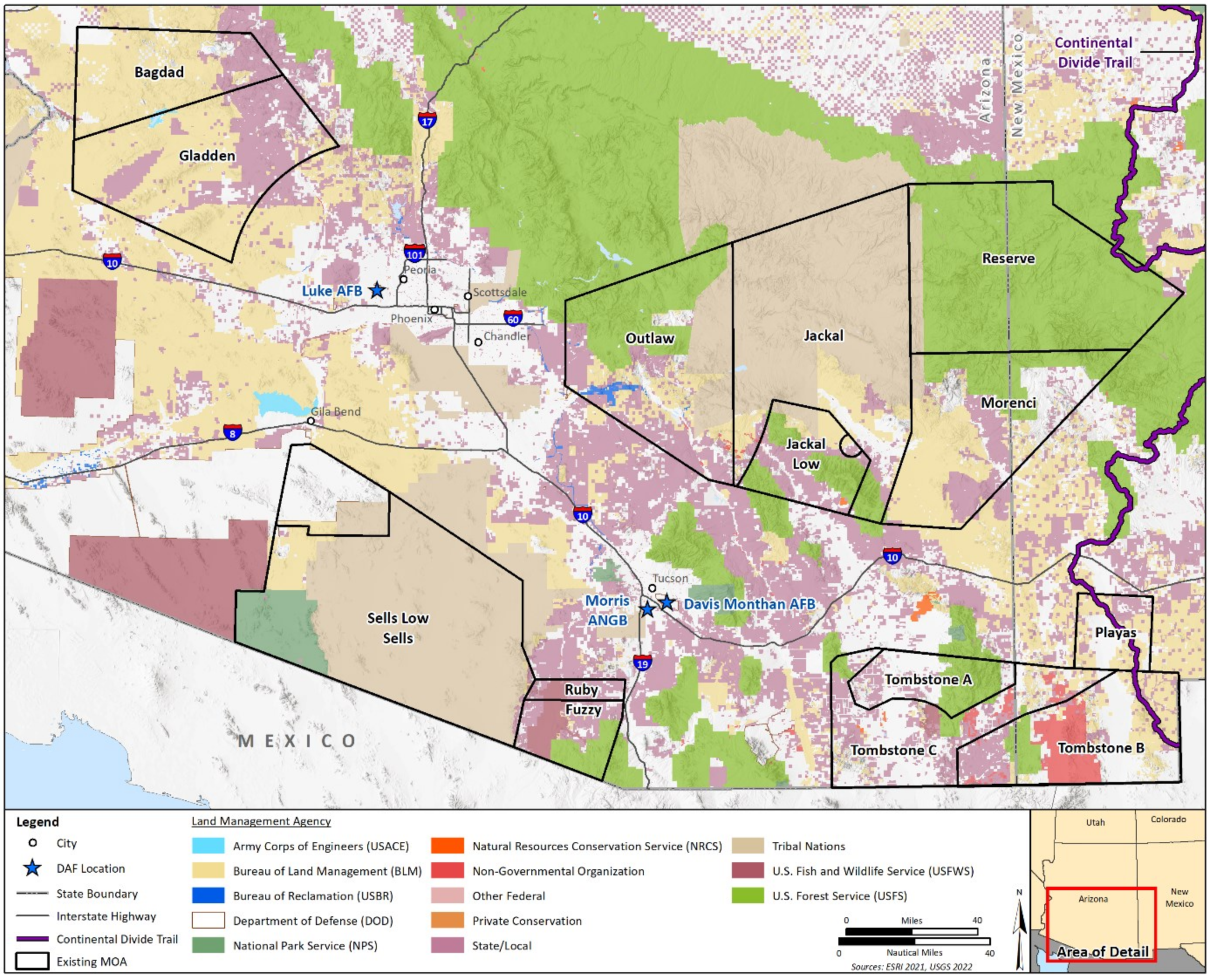
3.7.2 Affected Environment

As shown in **Figure 3.7-1**, *Land Ownership and Management Beneath Existing Airspace*, much of the land beneath the airspace is managed by Federal agencies, including the BLM, USFS, and NPS; state and local lands; and Tribal Nation lands. Common types of recreation that occur on the land beneath all the proposed airspace areas include hiking; viewing natural features, wildlife, and historic sites; camping; fishing; hunting; driving for pleasure; bicycling; horseback riding; water activities; and skiing. Recreational activities can occur on both public and private lands. In addition, the BLM manages lands that may be used for livestock grazing, or other ranching or farm-related activities. Most lands under the proposed MOAs are public, with the exception of the Tribal Nation lands. The vast majority of public lands under the proposed MOAs are managed by the BLM and USFS that provide access and recreational opportunities to the public. Wilderness Areas are discussed in **Section 3.7.2.4**.

3.7.2.1 Tombstone MOA

The existing Tombstone MOA and the proposed expansion area lie above lands in Cochise County in southeastern Arizona and Hidalgo and Luna Counties in southwestern New Mexico. The area is predominantly rural with population centers that include the towns of Animas and Hachita. **Table 3.7-1** shows land ownership in acres by agency, including recreational areas, beneath Tombstone C MOA and the proposed expansion area of Tombstone MOA. Acreages for Tombstone C MOA include only those areas with a "reportable" increase in noise which excludes Tombstone A, B, and the Exclusion area.

As shown in **Table 3.7-1**, lands beneath the Tombstone C MOA with a "reportable" increase and the Tombstone Proposed Expansion area are predominantly managed by the BLM and USFS, with a smaller portion of non-Federal lands, state/local agencies, USFWS, and NPS managed lands. State and local lands consist primarily of State Trust land, May Memorial Wildlife Area, Manhattan Claims Nature Reserve, and other smaller state and local parks. Portions of the Continental Divide Trail are located beneath the existing Tombstone MOA and within the proposed Tombstone Expansion area (see **Figure 3.7-1**). Acreage associated with the trail would be included in the relevant land management agencies and is not called out specifically in **Table 3.7-1**.



Legend: AFB = Air Force Base; ANGB = Air National Guard Base; DAF = Department of the Air Force; MOA = Military Operations Area.

Figure 3.7-1 Land Ownership and Management beneath MOAs

Table 3.7-1 Land Ownership and Recreational Areas Beneath the Tombstone MOA

Agency		Existing Acres
Tombstone C MOA[1]		
Non-Federal Lands		**72,801**
State / Local Lands		**99,192**
Tribal Nations		**0**
USFS	Chiricahua Roadless Area	6,190
	Coronado National Forest	42,721
	Lower Dragoon Roadless Area	1,165
	Middle Dragoon Roadless Area	2,881
	Peloncillo Roadless Area	3,690
Total USFS		**56,646**
BLM	Central Peloncillo Mountains Area of Critical Environmental Concern	12,307
	Gray Peak Wilderness Study Area	10,869
	Las Cruces District Office	63,183
	Safford Field Office	1,640
	Tucson Field Office	52
Total BLM		**88,051**
Total Tombstone C MOA		**316,690**
Tombstone (Proposed Expansion) MOA [2]		
Non-Federal Lands		**33**
State / Local Lands		**78,105**
Tribal Nations		**0**
NPS	Chiricahua National Monument	3,522
	Chiricahua National Monument Wilderness Area	3,531
Total NPS		**7,053**
USFS	Chiricahua Roadless Area	9,708
	Chiricahua Wilderness	11,483
	Coronado National Forest	66,221
	Middle Dragoon Roadless Area	4,488
	Taylor, Richard V.	1
	Upper Dragoon Roadless Area	689
Total USFS		**92,590**
BLM	Gray Peak Wilderness Study Area	3,483
	Las Cruces District Office	177,996
	National Public Lands	64
	Safford Field Office	2,308
Total BLM		**183,850**
Total Tombstone (Proposed Expansion) MOA		**361,631**

Note: Acreages are approximate as they have been derived from multiple data sources.
[1]Acreages for Tombstone C include only those areas with a "reportable" increase in noise which excludes Tombstone A, B, and the Exclusion Area.
[2]Acreages only include area proposed for the expansion.

Legend: BLM = Bureau of Land Management; MOA = Military Operations Area; NPS = National Park Service; USFS = U.S. Forest Service; USFWS = U.S. Fish and Wildlife Service.

Source: USGS 2022.

3.7.2.2 Jackal, Jackal Low, and Outlaw MOAs

Jackal, Jackal Low, and Outlaw MOAs lie above lands in Apache, Gila, Graham, Navajo, Pinal, and Maricopa Counties in southeastern Arizona. The area is predominantly rural with population centers that include the cities of Whiteriver, Safford, Mammoth, Miami, and Kearny. **Table 3.7-2** shows land ownership in acres by agency, including recreational areas, beneath the existing configurations of the Jackal, Jackal Low, and Outlaw MOAs. It should be noted that Jackal Low exists beneath the Jackal MOA, thus the acreages presented in **Table 3.7-2** for Jackal MOA include those reported for Jackal Low as well (see **Figure 3.7-1**). This land is predominantly managed by the BLM, USFS, Tribal Nations, and state/local agencies with a smaller portion of non-Federal agencies, U.S. Army Corps of Engineers (USACE), U.S. Bureau of Reclamation (USBR), and DoD managed lands. State and local lands consist primarily of State Trust land, Cluff Ranch Wildlife Area, Dry Lake Park, Graham County Fairgrounds, Roper Lake State Park, Round Mountain Park, San Pedro River Conservation Areas, and other smaller state and local parks.

Table 3.7-2 Land Ownership and Recreational Areas Beneath the Jackal, Jackal Low, and Outlaw MOAs

Agency		Existing Acres
Jackal MOA		
Non-Federal Lands		**4,759**
State/Local Lands		**284,722**
Tribal Nations (Fort Apache and San Carlos Reservations)		**1,955,234**
USFS	Apache National Forest	26
	Coronado National Forest	277,181
	Galiuro Roadless Area and Wilderness	39,145
	Goudy Canyon Research Natural Area Research Natural Area	554
	Mount Baldy Wilderness	26
	Mount Graham Wilderness Study Area	61,352
	Pinaleno Roadless Area	119,058
	Santa Teresa Roadless Area and Wilderness	35,841
Total USFS		**533,183**
BLM	Aravaipa Canyon Wilderness Area	11,784
	Bear Springs Badlands and Turkey Creek Riparian Areas of Critical Environmental Concern	5,430
	Table Mountain and Desert Grasslands Research Natural Areas of Critical Environmental Concern – Pilares and Sombrero Butte	934
	Fishhooks Wilderness Area	10,756
	Gila Box Riparian National Conservation Area	291
	North Santa Teresa Wilderness Area	5,809
	Safford Field Office	300,754
Total BLM		**335,758**
NRCS	Farm and Ranch Lands Protection Program	**2,298**
Total Jackal MOA		**3,115,954**
Jackal Low MOA (exists beneath Jackal MOA)		
Non-Federal Lands		**627**
State/Local Lands		**190,514**
Tribal Nations (San Carlos Reservation)		**47,915**

Agency		Existing Acres
USFS	Coronado National Forest	209,432
	Galiuro Roadless Area and Wilderness	39,807
	Goudy Canyon Research Natural Area Research Natural Area	554
	Mount Graham Wilderness Study Area	40,757
	Pinaleno Roadless Area	71,573
	Santa Teresa Roadless Area and Wilderness	35,841
Total USFS		**397,964**
BLM	Bear Springs Badlands Area of Critical Environmental Concern	3,215
	North Santa Teresa Wilderness Area	5,809
	Safford Field Office	66,213
Total BLM		**75,237**
Total Jackal Low MOA		**714,554**
Outlaw MOA		
Non-Federal Lands		**5,789**
State / Local Lands		**357,476**
Tribal Nations (San Carlos Reservation)		**363,142**
USBR		**27,787**
DoD (National Guard Florence Military Reservation)		**15,765**
USFS	Apache Leap Special Management Area Special Management Area	819
	Arizona National Scenic Trail	31
	Salt River Canyon Wilderness	17,665
	Summit Watersheds Research Area, Plo 3263 Withdrawal	320
	Superstition Wilderness	116,204
	Superstition Wilderness Water Sources, Plo 5368 Withdrawal	537
	Tonto National Forest	580,656
Total USFS		**716,232**
BLM	Aravaipa Canyon Wilderness Area	8,558
	Desert Grasslands Research Natural Area of Critical Environmental Concern – Mescal Ridge	381
	Lower Sonoran Field Office	6,610
	Needleseye Wilderness Area	8,711
	Safford Field Office	25,663
	San Pedro Ecosystem	216
	Table Mountain Research Natural Area of Critical Environmental Concern	747
	Tucson Field Office	213,125
	White Canyon Area of Critical Environmental Concern	291
	White Canyon Wilderness Area	5,772
Total BLM		**270,074**
Total Outlaw MOA		**1,756,264**

Note: Acreages are approximate as they have been derived from multiple data sources.
Legend: BLM = Bureau of Land Management; DoD = Department of Defense; MOA = Military Operations Area; NRCS = Natural Resources Conservation Service; USBR = U.S. Bureau of Reclamation; USFS = U.S. Forest Service.
Source: USGS 2022.

3.7.2.3 Bagdad and Gladden MOAs

Gladden/Bagdad MOAs lie above lands in La Paz, Maricopa, Mohave, and Yavapai Counties in western Arizona. The area is predominantly rural with population centers that include the cities of Aguila, Hillside, Peeples Valley, Yarnell, Congress, Bouse, Wenden, and Bagdad. **Table 3.7-3** shows land ownership in acres by agency, including recreational areas, beneath the existing configurations of the Gladden/Bagdad MOAs. As shown in **Table 3.7-3**, lands beneath the Gladden/Bagdad MOAs are primarily managed by the BLM with the remaining lands managed by state and local agencies and a smaller portion of USACE and USFWS managed lands. State and local lands consist primarily of State Trust land.

Table 3.7-3 Land Ownership and Recreational Areas Beneath the Gladden/Bagdad MOAs

Agency		**Existing Acres**
Gladden MOA		
State/Local Lands		**576,993**
USACE		**9,302**
BLM	Arrastra Mountain Wilderness Area	37,593
	Big Horn Mountains Wilderness Area	1,990
	Cactus Plain Wilderness Study Area	7,338
	East Cactus Plain Wilderness Area	14,132
	Harcuvar Mountains Wilderness Area	25,141
	Harquahala Mountains Area of Critical Environmental Concern	68,138
	Harquahala Mountains Wilderness Area	22,987
	Hassayampa Field Office	252,653
	Hummingbird Springs Wilderness Area	3,654
	Kingman Field Office	141,071
	Lake Havasu Field Office	497,338
	Rawhide Mountains Wilderness Area	36,910
	Swansea Historic District Area of Critical Environmental Concern	5,910
	Swansea Wilderness Area	4,059
	Three Rivers Riparian Area of Critical Environmental Concern	20,750
	Tres Alamos Wilderness Area	8,357
Total BLM		**1,148,020**
Total Gladden MOA		**1,734,314**
Bagdad MOA		
State/Local Lands		**135,113**
USACE		**4,133**
USFWS		**1,038**
BLM	Arrastra Mountain Wilderness Area	92,139.0
	Aubrey Peak Bighorn Sheep Habitat Area of Critical Environmental Concern	2,455.1
	Aubrey Peak Wilderness Area	14,846.5
	Burro Creek Riparian/Cultural Area of Critical Environmental Concern	15,489.7
	Clay Hills Research Natural Area of Critical Environmental Concern	1,116.8
	Kingman Field Office	514,596.6
	Lake Havasu Field Office	114,269.0
	McCracken Desert Tortoise Habitat Area of Critical Environmental Concern	33,197.7
	Poachie Desert Tortoise Habitat Area of Critical Environmental Concern	33,431.0
	Rawhide Mountains Wilderness Area	2,184.8
	Swansea Historic District Area of Critical Environmental Concern	13.8
	Swansea Wilderness Area	13,071.7
	Three Rivers Riparian Area of Critical Environmental Concern	21,172.6
	Upper Burro Creek (East) Wilderness Area	3,060.6
	Upper Burro Creek (West) Wilderness Area	6,973.9

Agency	Existing Acres
Total BLM	**868,019**
Total Bagdad MOA	**1,008,302**

Note: Acreages are approximate as they have been derived from multiple data sources.
Legend: BLM = Bureau of Land Management; MOA = Military Operations Area; USFWS = U.S. Fish and Wildlife Service; USACE = U.S. Army Corps of Engineers.
Source: USGS 2022.

3.7.2.4 Wilderness Areas

The Wilderness Act of 1964 established the National Wilderness Preservation System, a national network of more than 800 federally designated wilderness areas. These wilderness areas are managed by the NPS, BLM, USFWS, and USFS. As shown in **Table 3.7-4** and **Figure 3.7-2**, there are 31 designated Wilderness Areas located underneath the existing MOAs and the proposed Tombstone MOA Expansion area. Eighteen of these Wilderness Areas were established under the Arizona Desert Wilderness Act of 1990 which has a provision for military activities (see **Table 3.7-4).** This provision specifically states, "Nothing in this title shall preclude low-level overflights of military aircraft, the designation of new units of special airspace, or the use or establishment of military flight training routes over wilderness areas designated by this title" (Sec 101(a)(4)(i)).

3.7.3 Environmental Consequences

Land use is affected by changes that alter, detract, or eliminate use or enjoyment of a place. According to the FICUN, noise exposure greater than 65 dB DNL is considered generally incompatible with residential, public use (i.e., schools), or recreational and entertainment areas (FICUN 1980). The U.S. Army Public Health Command indicates that supersonic noise less than 62 dBC CDNL is compatible with all land uses and noise sensitive areas (U.S. Army Center for Health Promotion and Preventive Medicine 2005). Since the Proposed Action would not involve any land under the MOAs being exposed to noise levels greater than 65 dB DNL or 62 dBC CDNL, no incompatible land uses or significant impacts to land uses or recreational uses as a result of increases in noise related to the Proposed Action would occur.

FAA regulations specify minimum safe altitudes and avoidance distances aircraft must adhere to when flying over specific types of structures, settlements, or categories of land. In accordance with FAA regulations (14 CFR 91.119), aircraft must avoid congested areas of a city, town, or settlement or any open-air assembly of people by 1,000 feet above the highest obstacle within a horizontal radius of 2,000 feet. Outside congested areas, aircraft must avoid persons, vessels, vehicles, or structures by 500 feet. In addition, MOAs must exclude the airspace 1,500 feet AGL and below within a 3 nautical mile radius of airports available for public use. These required low-altitude avoidances would be charted and published by the FAA and/or identified in the local flight instructions for pilots. Pilots would be instructed to avoid these locations by horizontal and vertical distances to enhance flight safety, noise abatement, and environmental sensitivity. Even with these avoidance distances, there would be a potential for perceptible increases in noise levels for some rural residents to occur.

Table 3.7-4 Wilderness Areas Beneath MOAs

Wilderness Area	Associated MOA	Percent Under Airspace	Enabling Act Allows Low-level Military Flight
Chiricahua National Monument Wilderness Area[1]	Tombstone Expansion	0% (34%)	No, Arizona Wilderness Act of 1984, PL 98406, 98 STAT 1485, Sec 105
Chiricahua Wilderness[2]	Tombstone	87% (100%)	No, Arizona Wilderness Act of 1984, PL 98406, 98 STAT 1485, Sec 101(a)(5)
Needle's Eye Wilderness	Outlaw	100%	Yes, AZ Desert Wilderness Act of 1990 Sec 101(a)(20) & Sec 101(i)
White Canyon Wilderness	Outlaw	100%	Yes, AZ Desert Wilderness Act of 1990 Sec 101(a)(35) & Sec 101(i)
Superstition Wilderness	Outlaw	72%	No, Arizona Wilderness Act of 1984, PL 98406, 98 STAT 1485, Sec 101(a)(24)
Salt River Canyon Wilderness	Outlaw	54%	No, Arizona Wilderness Act of 1984, PL 98406, 98 STAT 1485, Sec 101(a)(21)
Aravaipa Canyon Wilderness	Jackal, Outlaw	100%	Yes, AZ Desert Wilderness Act of 1990 Sec 101(a)(39) & Sec 101(i)
Fishhooks Wilderness	Jackal	100%	Yes, AZ Desert Wilderness Act of 1990 Sec 101(a)(22) & Sec 101(i)
Galiuro Wilderness	Jackal, Jackal Low	25%	No, Arizona Wilderness Act of 1984, PL 98406, 98 STAT 1485, 101(a)(8)
Santa Teresa Wilderness	Jackal, Jackal Low	100%	No, Arizona Wilderness Act of 1984, PL 98406, 98 STAT 1485, 101(a)(23)
North Santa Teresa Wilderness	Jackal, Jackal Low	100%	Yes, AZ Desert Wilderness Act of 1990 Sec 101(a)(21) & Sec 101(i)
Mount Baldy Wilderness	Jackal, Reserve	100%	No, 91-504-OCT. 23, 1970, Sec 3
Gila Wilderness	Reserve, Morenci	42%	No, various, incl 1980 Act adding to NM Wilderness, PL 96-550, 94 STAT. 3221, Sec 102a.(1 & 7)
Bear Wallow Wilderness	Reserve	100%	No, Arizona Wilderness Act of 1984, PL 98406, 98 STAT 1485, Sec 101(a)(3)
Blue Range Wilderness	Reserve	100%	No, 1980 Act adding to NM Wilderness, PL 96-550, 94 STAT. 3221, Sec 102a.(3)
Escudilla Wilderness	Reserve	100%	No, Arizona Wilderness Act of 1984, PL 98406, 98 STAT 1485, Sec 101(a)(30)
Aubrey Peak Wilderness	Bagdad	100%	Yes, AZ Desert Wilderness Act of 1990Sec 101(a)(5) & Sec 101(i)
Upper Burro Creek Wilderness	Bagdad	36%	Yes, AZ Desert Wilderness Act of 1990 Sec 101(a)(33) & Sec 101(i)
Arrastra Mountain Wilderness	Bagdad, Gladden	100%	Yes, AZ Desert Wilderness Act of 1990 Sec 101(a)(8) & Sec 101(i)
Swansea Wilderness	Bagdad, Gladden	100%	Yes, AZ Desert Wilderness Act of 1990 Sec 101(a)(26) & Sec 101(i)
Rawhide Mountains Wilderness	Bagdad, Gladden	100%	Yes, AZ Desert Wilderness Act of 1990 Sec 101(a)(7) & Sec 101(i)
East Cactus Plain Wilderness	Gladden	100%	Yes, AZ Desert Wilderness Act of 1990 Sec 101(a)(6) & Sec 101(i)
Hummingbird Springs Wilderness	Gladden	11%	Yes, AZ Desert Wilderness Act of 1990 Sec 101(a)(12) & Sec 101(i)
Big Horn Mountains Wilderness	Gladden	10%	Yes, AZ Desert Wilderness Act of 1990 Sec 101(a)(11) & Sec 101(i)
Harcuvar Mountains Wilderness	Gladden	100%	Yes, AZ Desert Wilderness Act of 1990 Sec 101(a)(9) & Sec 101(i)
Harquahala Mountains Wilderness	Gladden	100%	Yes, AZ Desert Wilderness Act of 1990 Sec 101(a)(10) & Sec 101(i)
Tres Alamos Wilderness	Gladden	100%	Yes, AZ Desert Wilderness Act of 1990 Sec 101(a)(36) & Sec 101(i)
Cabeza Prieta Wilderness[3]	Sells, Sells Low	<1%	Yes, AZ Desert Wilderness Act of 1990 Sec 101(a)(4) & Sec 101(i) & 301(f)
Organ Pipe Cactus Wilderness	Sells, Sells Low	99%	No, PL 95-625—NOV. 10, 1978 92 STAT. 3467

Wilderness Area	Associated MOA	Percent Under Airspace	Enabling Act Allows Low-level Military Flight
Baboquivari Peak Wilderness	Sells, Sells Low	100%	Yes, AZ Desert Wilderness Act of 1990 Sec 101(a)(19) & Sec 101(i)
Pajarita Wilderness	Ruby, Fuzzy	72%	No, Arizona Wilderness Act of 1984, PL 98406, 98 STAT 1485, Sec 101(a)(17)

Notes: [1]Chiricahua National Monument Wilderness Area is currently not beneath any airspace; 34 percent of this Wilderness would occur under the proposed Tombstone Expansion (Alternatives 2 and 4).
[2]Chiricahua Wilderness is partially beneath the existing Tombstone MOA (87 percent); 100 percent of the wilderness would occur under the MOA under alternatives that include the Tombstone Expansion (Alternatives 2 and 4).
[3]The eastern boundary of the Cabeza Prieta Wilderness slightly overlaps the western boundary of the Sells MOA. The majority of this Wilderness is located beneath R-2301E which is not part of this EIS.

Legend: % = percent; < = less than; AZ = Arizona; MOA = Military Operations Area; PL = Public Law; Sec = Section; STAT = Statute.

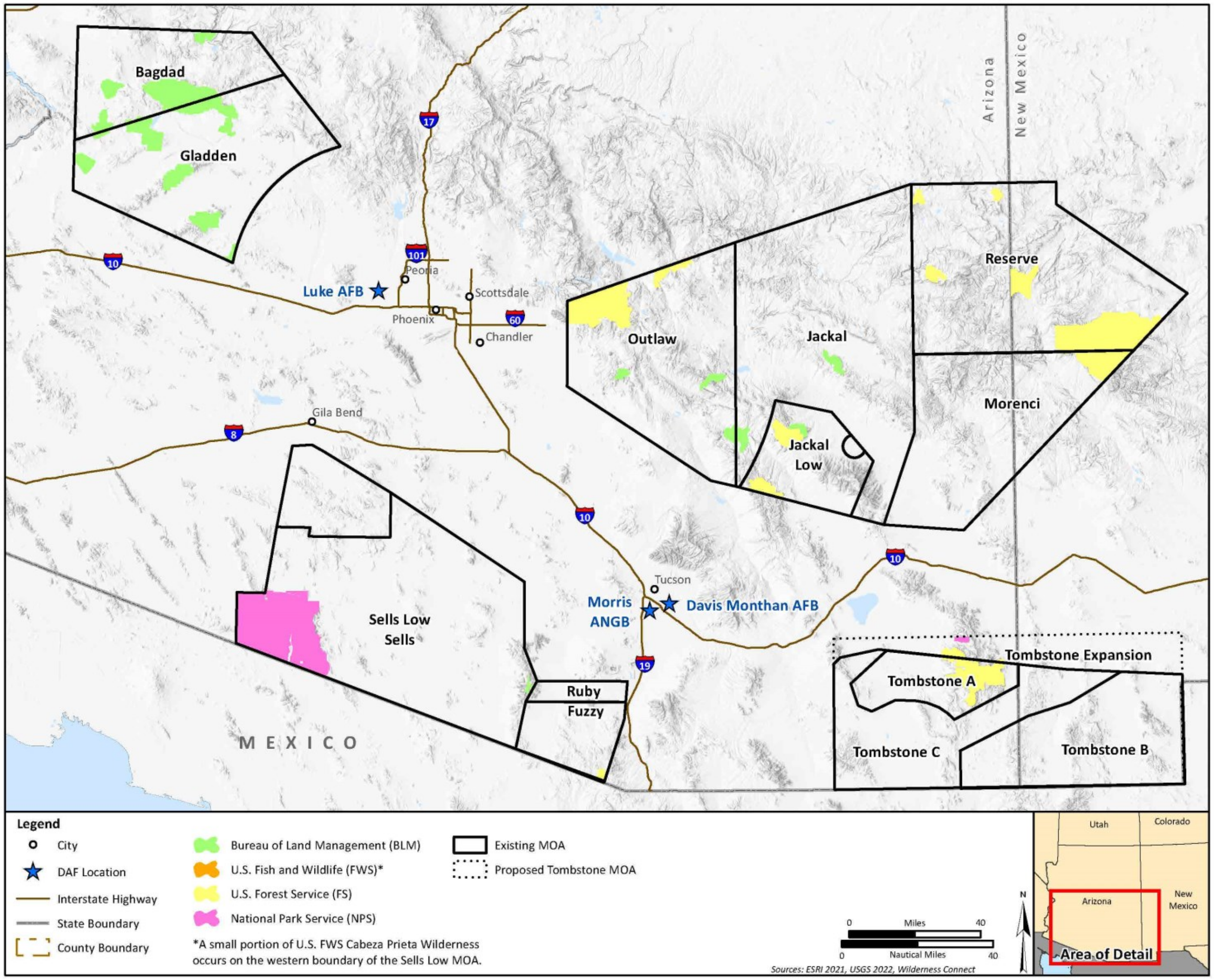


Figure 3.7-2 Wilderness Areas Associated with the MOAs

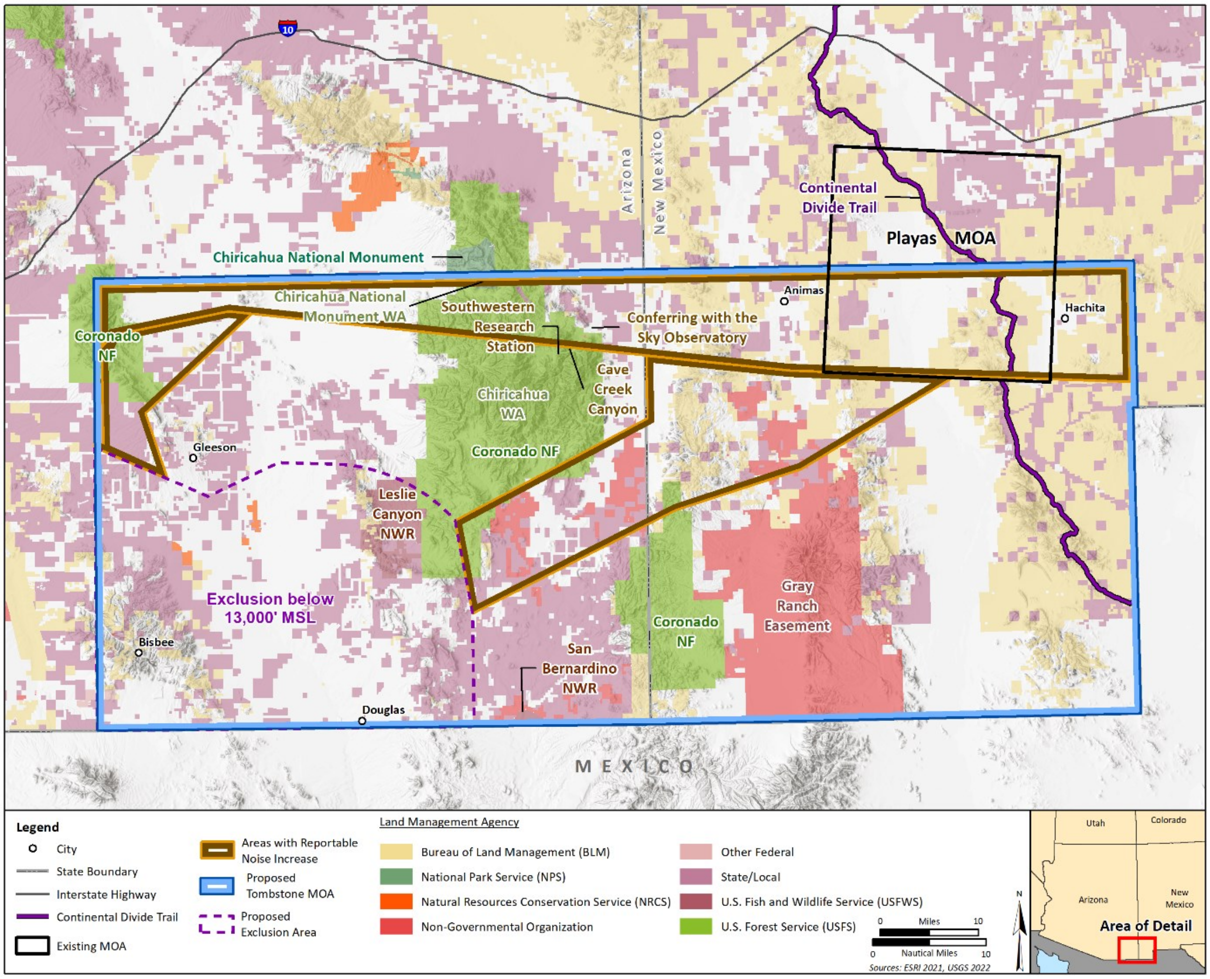
3.7.3.1 Alternative 1 – No Action

Under the No Action Alternative, the MOAs would continue to be used for military training as they are currently. As shown in **Section 3.4.3.3**, none of the lands beneath the MOAs have a noise exposure that exceeds 65 dB DNL or 62 dBC CDNL. Thus, the noise exposure is considered compatible with all land uses. Individuals recreating on lands beneath the MOAs could potentially see or hear low-level military aircraft, specifically in those MOAs with an existing low floor such as Tombstone (500 feet AGL), Jackal Low (100 feet AGL), and Fuzzy (100 feet AGL) MOAs. As shown in **Table 3.4-6,** the percent chance of experiencing a low-level overflight in these MOAs is very low. The peak noise exposure during a low-level overflight lasts for approximately 1/8 of second but the total sound may be heard for 1 minute or more depending on the topography and surrounding environmental conditions. Given the recreation activity or situation, the sound may be annoying or startling to a person or wildlife, may mask natural sounds like bird calls or rustling leaves, or temporarily interrupt outdoor conversation. Sonic booms are possible in all MOAs except for Ruby and Fuzzy MOAs which are not authorized for supersonic operations. The intensity of a sonic boom would vary and depend on a number of atmospheric, distance, and aircraft conditions but most often sounds like a loud explosion or a thunderclap and would induce a similar reaction as described above (startling, disrupt conversation, etc.). The same general impacts from noise exposure would continue to occur in Wilderness Areas that exist beneath the MOAs.

3.7.3.2 Alternative 2 – Proposed Action

Areas with Reportable Noise Increases

Alternative 2 would result in reportable increases in subsonic noise in the Tombstone C (only areas outside of Tombstone A, B, and the Exclusion Area), Tombstone Expansion area, Jackal, Jackal Low, and Bagdad/Gladden MOAs. **Figure 3.7-3** illustrates the areas with reportable increases in the proposed Tombstone MOA; refer to **Figure 3.7-1** for Jackal, Jackal Low, Bagdad/Gladden MOAs. While the Proposed Action would result in “reportable” increases in noise exposure in these locations, and while overflights would be audible particularly in quiet locations, all of the noise levels are compatible with all land use types to include residential, public use (i.e., schools), or recreational and entertainment areas. Similarly, supersonic noise levels in all airspace units would not increase to levels that are expected to result in annoyance or affect noise sensitive areas. Individuals recreating on lands beneath the MOAs could potentially see or hear low-level military aircraft as they do currently; however, these flights could occur lower than they do currently. As shown in **Table 3.4-6** the percent chance of experiencing low-level overflights is very low. The experience for a person recreating beneath the MOAs would be similar to that described in **Section 3.7.3.1**, and they may be annoyed, startled, or have to temporarily pause conversation during an overflight. The peak noise level would be higher than the current experience so these reactions to the overflight may be stronger.



Legend: MOA = Military Operations Area; MSL = mean sea level; NF = National Forest; NWR = National Wildlife Refuge.

Figure 3.7-3 Proposed Tombstone MOA Areas of Reportable Noise Increase

The Continental Divide Trail is a National Scenic Trail that stretches approximately 3,100 miles through the U.S. between the borders of Mexico and Canada. Portions of the Continental Divide Trail are located under the Tombstone MOA (see **Figure 3.7-3**). As shown, the trail currently exists beneath the Tombstone B MOA and also the Playas MOA. The section of the trail beneath the Tombstone B MOA would have little to no change in the current recreational experience. Low-level overflights currently exist in this area (down to 500 feet AGL) and the Proposed Action would not substantially change that experience. The section of the trail that traverses the proposed Tombstone expansion area would be in an area that currently has little military overflight activity (there is some activity associated with Playas MOA) and the Proposed Action would have a reportable increase in noise, although the cumulative noise would be below the level considered to be incompatible with recreation. Individuals along the trail may experience an occasional low-level overflight but this would not be a frequent or repetitive experience (see **Table 3.4-6**). This experience would be similar to what is currently experienced along the section of trail beneath the existing Tombstone B MOA.

A very small section of the trail also overlaps the northern boundary of the Reserve MOA (see **Figure 3.7-1**). The noise exposure beneath the Reserve MOA would be very low (39.2 dB DNL) and there would be little to no change from the current experience along this section of trail. Given the location of the trail along the boundary of the MOA, it would be unlikely that anyone would experience a direct overflight. While supersonic noise in the Reserve MOA would increase slightly under the Proposed Action, it would remain well below a level expected to be incompatible with recreation. The trail would be in the 25–35 dBC CDNL contour which would be a negligible change (see **Section 3.4.3.4, Figure 3.4-6**).

Wilderness Areas

Given the nature of Wilderness Areas, special consideration for the noise exposure has been given for those areas. The subsonic and supersonic noise exposure comparison for all wilderness areas for Alternative 1 – No Action and Alternative 2 – Proposed Action is provided in **Table 3.7-5**. As shown, none of the subsonic or supersonic noise exposure levels exceed levels indicating incompatibility with any land uses (65 dB DNL or 62 dBC CDNL). Eighteen of the wilderness areas have a provision that allows for low-level military overflight and the establishment of SUA; thus the associated noise exposure from the Proposed Action is not expected to be incompatible with these areas and no additional consideration is warranted. The remaining 13 Wilderness Areas are discussed in the following sections.

Associated with the Tombstone MOA are the Chiricahua Wilderness and the Chiricahua National Monument Wilderness. The Chiricahua Wilderness exists beneath the current Tombstone A MOA and the subsonic noise exposure would decrease in this area. The supersonic noise exposure would increase slightly; however, it is extremely low in all of the Tombstone MOA given the limited supersonic operations expected in this MOA. A person recreating in the wilderness area could experience the occasional low-level overflight, but this experience is expected to be relatively the same as what is currently experienced. The Chiricahua National Monument Wilderness is not currently beneath a MOA but the proposed Tombstone Expansion would overlie this Wilderness. The change in subsonic noise exposure (DNL) would likely be noticeable in this area and a person recreating in the area could experience the occasional low-level overflight. As described previously, the sound may be annoying or startling to a person or wildlife, may mask natural sounds like bird calls or rustling leaves, or temporarily interrupt outdoor conversation. This experience would not occur with any sort of regularity or be a repetitive situation in any location.

Associated with the Reserve and Morenci MOAs are the Mount Baldy Wilderness, Gila Wilderness, Bear Wallow Wilderness, Blue Range Wilderness, and Escudilla Wilderness. The change in subsonic noise (DNL) in all of these areas would be minimal as there would be no change to the vertical dimensions of these MOAs. The change in supersonic noise (CDNL) could be noticeable, although the CDNL values are still very low. The lowered authorized supersonic altitude (down to 5,000 feet AGL) would increase the intensity of any potential sonic boom at these lower altitudes (see **Section 3.4.3.4**, *Supersonic Noise Exposure,* for additional details). The Reserve and Morenci MOAs would be used in conjunction with the Outlaw and Jackal MOAs for supersonic operations. This MOA complex covers a vast geography and supersonic flight could occur anywhere in this space, but would likely be concentrated towards the center of the MOAs.

Table 3.7-5 Subsonic and Supersonic Noise Exposure in Wilderness Areas – Alternative 2

Wilderness Area	Associated MOA	Military Provision?	Alternative 1 – No Action		Alternative 2 – Proposed Action	
			Subsonic (DNL)	Supersonic (CDNL)	Subsonic (DNL)	Supersonic (CDNL)
Chiricahua National Monument	Tombstone Expansion	No	–	–	53.6	7–17
Chiricahua Wilderness	Tombstone	No	56.0	12–23	53.6	19–31
Needle's Eye Wilderness	Outlaw	Yes	37.8	32–34	42.5	41–43
White Canyon Wilderness	Outlaw	Yes	37.8	29–30	42.5	38–39
Superstition Wilderness	Outlaw	No	37.8	22–30	42.5	30–39
Salt River Canyon Wilderness	Outlaw	No	37.8	22–28	42.5	32–37
Aravaipa Canyon Wilderness	Jackal, Outlaw	Yes	37.3 - 37.8	28–31	42.5–47.3	36–40
Fishhooks Wilderness	Jackal	Yes	37.3	34–35	47.3	43–44
Galiuro Wilderness	Jackal, Jackal Low	No	48.6	19–25	55.8	26–34
Santa Teresa Wilderness	Jackal, Jackal Low	No	48.6	31–33	55.8	40–42
North Santa Teresa Wilderness	Jackal, Jackal Low	Yes	48.6	32–33	55.8	41–42
Mount Baldy Wilderness	Jackal, Reserve	No	38.6	18–21	39.2	28–31
Gila Wilderness	Reserve, Morenci	No	38.6 - 42.4	13–27	39.2–43.1	21–35
Bear Wallow Wilderness	Reserve	No	38.6	28–29	39.2	37–38
Blue Range Wilderness	Reserve	No	38.6	28–31	39.2	37–39
Escudilla Wilderness	Reserve	No	38.6	22–24	39.2	31–33
Aubrey Peak Wilderness	Bagdad	Yes	50.5	45–48	57.6	46–49
Upper Burro Creek Wilderness	Bagdad	Yes	50.5	11–37	57.6	13–48
Arrastra Mountain Wilderness	Bagdad, Gladden	Yes	50.5	47–48	57.6	48–52
Swansea Wilderness	Bagdad, Gladden	Yes	50.5	38–44	57.6	41–46
Rawhide Mountains Wilderness	Bagdad, Gladden	Yes	50.5	46–50	57.6	48–52
East Cactus Plain Wilderness	Gladden	Yes	50.5	38–42	57.6	41–44
Hummingbird Springs Wilderness	Gladden	Yes	50.5	35–40	57.6	37–42
Big Horn Mountains Wilderness	Gladden	Yes	50.5	35–39	57.6	36–40
Harcuvar Mountains Wilderness	Gladden	Yes	50.5	46–50	57.6	48–52
Harquahala Mountains Wilderness	Gladden	Yes	50.5	42–44	57.6	43–46
Tres Alamos Wilderness	Gladden	Yes	50.5	48–49	57.6	50–50
Cabeza Prieta Wilderness	Sells, Sells Low	Yes	48.5	42–50	49.3	44–51
Organ Pipe Cactus Wilderness	Sells, Sells Low	No	48.5	42–53	49.3	43–54
Baboquivari Peak Wilderness	Sells, Sells Low	Yes	48.5	44–45	49.3	44–45
Pajarita Wilderness	Ruby, Fuzzy	No	57.8	32–35	59.6	31–33

Legend: CDNL = C-weighted Day-Night Average Sound Level; DNL = Day-Night Average Sound Level; MOA = Military Operations Area.

Research (Plotkin 1990) shows that high intensity sonic booms are rare in military training events. The intensity of a sonic boom would vary and depend on a number of atmospheric, distance, and aircraft conditions but most often sounds like a loud explosion or a thunderclap (see **Section 3.4.3.2**, *Sonic Boom Calculations* for specific overpressure calculations). Experiencing a supersonic overflight at these levels would be startling to a person on the ground, particularly in a setting that is supposed to be quiet and lack human interruption. However, like a subsonic low-level overflight, such an experience is expected to be rare and would not occur repetitively in a given location or be a frequent event.

Associated with the Outlaw and Jackal MOAs are the Superstition Wilderness, Salt River Canyon Wilderness, Galiuro Wilderness, and Santa Teresa Wilderness. While the DNL and CDNL are moderately low in these MOAs, the changes in noise exposure would likely be noticeable in these areas since the Proposed Action is to lower the subsonic floor of these MOAs to 500 feet AGL and the supersonic floor to 5,000 feet AGL. A person in these areas could experience a low-level overflight (subsonic and supersonic speeds). As described previously, these sounds may be annoying or startling to a person or wildlife, may mask natural sounds like bird calls or rustling leaves, or temporarily interrupt outdoor conversation. The potential exposure to such a flight would be rare as described above.

Associated with the Sells, Ruby, Fuzzy MOAs are the Organ Pipe Cactus Wilderness and the Pajarita Wilderness. The changes in subsonic (DNL) and supersonic (CDNL) are minor as there are no proposed vertical changes in these MOAs or the supersonic authorization. The changes in noise exposure in these MOAs is attributed to the 10 percent increase applied for analysis purposes to allow for annual fluctuations in use of all the MOAs (see **Section 2.2.2**). A person recreating in either of these areas could experience the occasional low-level overflight, which would be the same as the current situation. The changes in noise exposure in these MOAs is not expected to be noticeable by individuals recreating in these areas.

3.7.3.3 Alternative 3

<u>Areas with Reportable Noise Increases</u>

As shown in **Section 3.4.3.5**, none of the lands beneath the MOAs have a noise exposure that exceeds 65 dB DNL. Thus, the noise exposure would not be considered incompatible with any land uses. Alternative 3 would include the same vertical changes to the MOAs as described for Alternative 2 except for Jackal MOA which would be lowered to 100 feet AGL and the northern expansion of the Tombstone MOA would not occur. These changes would result in reportable subsonic noise increases to Tombstone C (only the areas outside of Tombstone A, B, and the Exclusion Area), Jackal MOA, and Bagdad/Gladden MOAs. As with Alternative 2, these subsonic noise levels are compatible with all land uses and supersonic noise levels would not increase to levels that are expected to result in high levels of annoyance or affect noise sensitive areas. Potential low-level flights are possible and the experience for people recreating beneath the MOAs would be the same as described in Alternative 2. The sound may be annoying or startling to a person or wildlife, may mask natural sounds like bird calls or rustling leaves, or temporarily interrupt outdoor conversation. This experience would not occur with any sort of regularity or be a repetitive situation in any location (see **Table 3.4-6**).

Wilderness Areas

The subsonic and supersonic noise exposure comparison for Alternative 1 - No Action and Alternative 3 is provided in **Table 3.7-6**. As shown, none of the subsonic or supersonic noise exposure levels exceed levels indicating incompatibility with any land uses (65 dB DNL or 62 dBC CDNL). Eighteen of the wilderness areas have a provision of low-level military overflight which does not preclude military overflights or the establishment of special use airspace (see **Table 3.7-5**). The associated noise exposure is not expected to be incompatible with these areas and they are not presented in **Table 3.7-6**. The Tombstone Expansion would not occur under Alternative 3, which would eliminate the potential impact to Chiricahua National Monument Wilderness described under Alternative 2. The DNL results for Alternative 3 are slightly different for Tombstone, Jackal, and Outlaw, however the impact discussion for the Wilderness Areas associated with these MOAs would be the same. The supersonic authorization under Alternative 3 would be the same as Alternative 2, thus those potential impacts are the same as those described for Alternative 2.

3.7.3.4 Alternative 4

Areas with Reportable Noise Increases

As shown in **Section 3.4.3.6**, none of the lands beneath the MOAs have a noise exposure that exceeds 65 dB DNL or 62 dBC CDNL. Thus, the noise exposure would not be considered incompatible with any land uses. This alternative would have the same vertical and horizontal changes to the MOAs as Alternative 2, except the proposed supersonic altitudes would be higher. The reportable noise increases would be the same as those described for Alternative 2: Tombstone C (areas outside of Tombstone A, B, and the Exclusion Area only), Tombstone Expansion area, Jackal, Jackal Low, and Bagdad/Gladden Bagdad MOAs. The supersonic noise levels in all airspace units would not increase to levels that are expected to result in high levels of annoyance or affect noise sensitive areas. Potential low-level flights are possible and the experience for people recreating beneath the MOAs would be the same as described in Alternative 2. The sound may be annoying or startling to a person or wildlife, may mask natural sounds like bird calls or rustling leaves, or temporarily interrupt outdoor conversation. This experience would not occur with any sort of regularity or be a repetitive situation in any location (see **Table 3.4-6**).

Wilderness Areas

The subsonic and supersonic noise exposure comparison for Alternative 1 – No Action and Alternative 4 is provided in **Table 3.7-7**. As shown, none of the subsonic or supersonic noise exposure levels exceed levels indicating incompatibility with any land uses (65 dB DNL or 62 dBC CDNL). Eighteen of the wilderness areas have a provision of low-level military overflight which does not preclude military overflights or the establishment of SUA (see **Table 3.7-5**). The associated noise exposure is not expected to be incompatible with these areas and they are not presented in **Table 3.7-7**. Alternative 4 includes the Tombstone Expansion and the same vertical adjustments to the subsonic floors of Tombstone, Outlaw, Jackal, Bagdad, and Gladden MOAs as proposed for Alternative 2 and the DNL results, and thus the potential impacts from subsonic noise are the same.

Table 3.7-6 Subsonic and Supersonic Noise Exposure in Wilderness Areas – Alternative 3

Wilderness Area	Associated MOA	Military Provision?	Alternative 1 - No Action		Alternative 3	
			Subsonic (DNL)	Supersonic (CDNL)	Subsonic (DNL)	Supersonic (CDNL)
Chiricahua Wilderness	Tombstone	No	56.0	12–23	54.7	19–31
Superstition Wilderness	Outlaw	No	37.8	22–30	42.5	30–39
Salt River Canyon Wilderness	Outlaw	No	37.8	22–28	42.5	32–37
Galiuro Wilderness	Jackal, Jackal Low	No	48.6	19–25	49.6	26–34
Santa Teresa Wilderness	Jackal, Jackal Low	No	48.6	31–33	49.6	40–42
Mount Baldy Wilderness	Jackal, Reserve	No	38.6	18–21	39.2	28–31
Gila Wilderness	Reserve, Morenci	No	38.6 - 42.4	13–27	39.2–43.1	21–35
Bear Wallow Wilderness	Reserve	No	38.6	28–29	39.2	37–38
Blue Range Wilderness	Reserve	No	38.6	28–31	39.2	37–39
Escudilla Wilderness	Reserve	No	38.6	22–24	39.2	31–33
Organ Pipe Cactus Wilderness	Sells, Sells Low	No	48.5	42–53	49.3	43–54
Pajarita Wilderness	Ruby, Fuzzy	No	57.8	32–35	59.6	31–33

Legend: CDNL = C-weighted Day-Night Average Sound Level; DNL = Day-Night Average Sound Level; MOA = Military Operations Area.

Table 3.7-7 Subsonic and Supersonic Noise Exposure in Wilderness Areas – Alternative 4

Wilderness Area	Associated MOA	Military Provision?	Alternative 1 – No Action		Alternative 4	
			Subsonic (DNL)	Supersonic (CDNL)	Subsonic (DNL)	Supersonic (CDNL)
Chiricahua National Monument	Tombstone Expansion	No	–	–	53.6	5–15
Chiricahua Wilderness	Tombstone	No	56.0	12–23	53.6	18–29
Superstition Wilderness	Outlaw	No	37.8	22–30	42.5	29–37
Salt River Canyon Wilderness	Outlaw	No	37.8	22–28	42.5	30–36
Galiuro Wilderness	Jackal, Jackal Low	No	48.6	19–25	55.8	25–33
Santa Teresa Wilderness	Jackal, Jackal Low	No	48.6	31–33	55.8	38–40
Mount Baldy Wilderness	Jackal, Reserve	No	38.6	18–21	39.2	27–29
Gila Wilderness	Reserve, Morenci	No	38.6 - 42.4	13–27	39.2–43.1	19–34
Bear Wallow Wilderness	Reserve	No	38.6	28–29	39.2	35–36
Blue Range Wilderness	Reserve	No	38.6	28–31	39.2	35–38
Escudilla Wilderness	Reserve	No	38.6	22–24	39.2	29–31
Organ Pipe Cactus Wilderness	Sells, Sells Low	No	48.5	42–53	49.3	43–54
Pajarita Wilderness	Ruby, Fuzzy	No	57.8	32–35	59.6	31–33

Legend: CDNL = C-weighted Day-Night Average Sound Level; DNL = Day-Night Average Sound Level; MOA = Military Operations Area.

Under Alternative 4, the supersonic authorization would be lowered to 10,000 feet AGL in Tombstone, Outlaw, Jackal, Morenci, and Reserve MOAs. The potential impacts from sonic booms and the typical reaction to this noise would be the same as described in **Section 3.7.3.2**, but the intensity of individual booms would be slightly less since supersonic flight would be higher.

3.7.4 Cumulative Impacts

While noise would increase beneath the MOAs, levels would be well below the threshold of 65 dB DNL considered to be incompatible with residential and recreational land uses. Other activities that could affect land use in the ROI include management undertaken by the BLM, USFS, localities, and other land managers as outlined in management and comprehensive plans (see **Appendix G**). The Proposed Action would not impede or interact with any of these existing or planned management activities and there would be no cumulative effect. Proposed airspace modifications would not alter, prohibit, or otherwise limit the public's access to the recreational areas beneath the MOAs and therefore would not contribute to cumulative impacts to these resources.

3.7.5 Mitigations

There are no significant impacts to land management and recreation, thus there are no mitigations required.

3.8 SOCIOECONOMICS

3.8.1 Resource Definition and Regulatory Framework

Socioeconomics is an umbrella term used to describe aspects of a project that are either social or economic in nature, or a combination of the two. The CEQ regulations implementing NEPA state that economic or social effects by themselves do not require preparation of an EIS. However, when the action proponent determines that economic or social and natural or physical environmental effects are interrelated, the EIS shall discuss and give appropriate consideration to these effects on the human environment (40 CFR 1502.16(b)). The CEQ regulations define the human environment as "comprehensively the natural and physical environment and the relationship of present and future generations of Americans with that environment" (40 CFR 1508.1(m)).

For this EIS, socioeconomics assessment will examine potential future effects of the Proposed Action on economic indicators including employment, income populations, and housing.

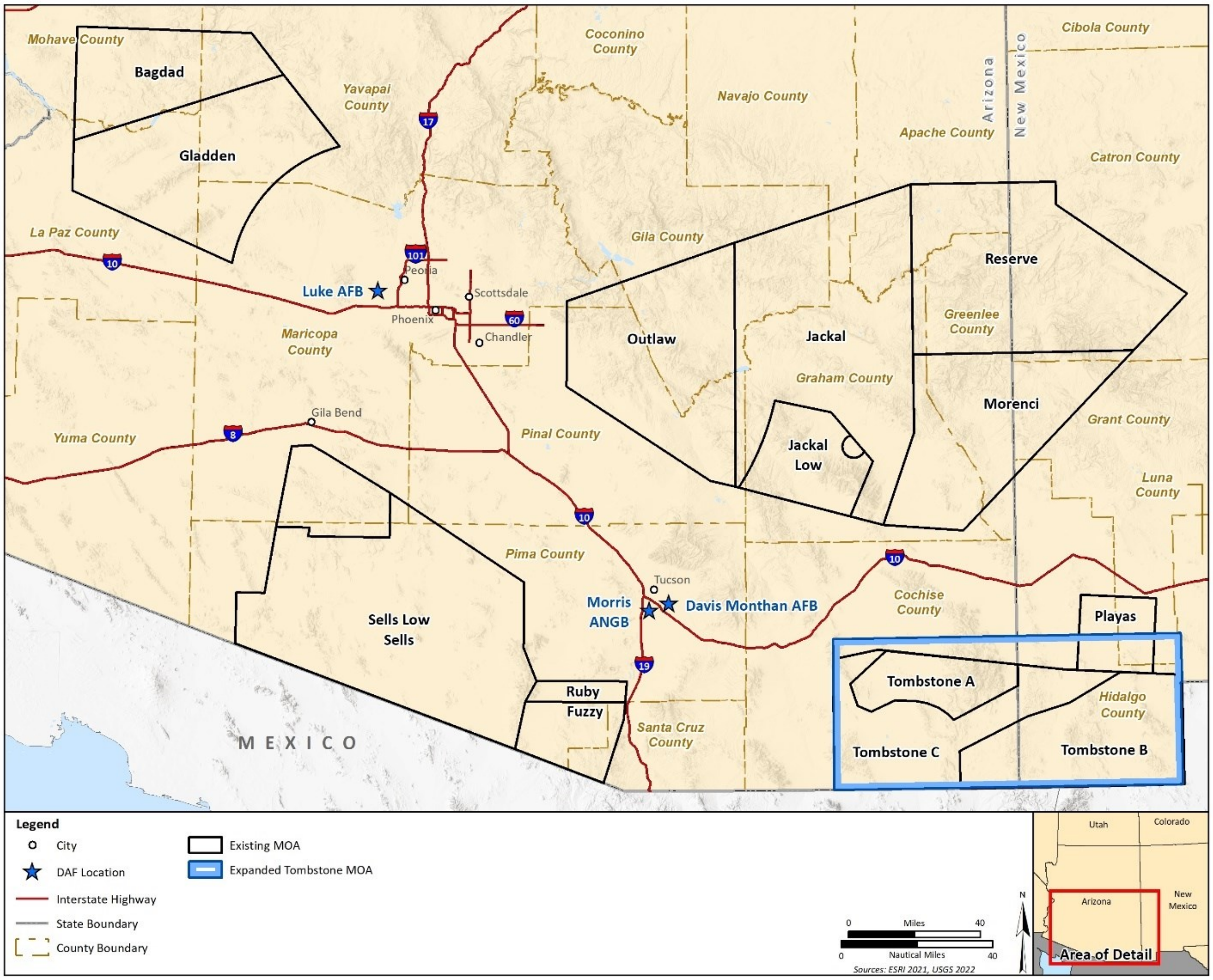
3.8.2 Affected Environment

The MOAs associated with this EIS are located throughout Arizona and a portion of New Mexico. The socioeconomic data presented in this section is organized by county. Some counties lie beneath more than one MOA; **Table 3.8-1** provides a list of the counties associated with each MOA, also shown in **Figure 3.8-1.** Information about the population, housing characteristics, and economic characteristics is provided in the following sections for each county and Arizona and New Mexico for comparison.

Table 3.8-1 Counties Associated with MOAs

MOA	Associated Counties
Tombstone	Cochise, AZ Hidalgo, NM Luna, NM (proposed expansion only) Grant, NM (proposed expansion only)
Outlaw	Gila, AZ Maricopa, AZ Pinal, AZ
Jackal	Apache, AZ Gila, AZ Graham, AZ Navajo, AZ Pinal, AZ
Jackal Low	Graham, AZ Pinal, AZ
Morenci	Graham, AZ Greenlee, AZ Catron, NM Hidalgo, NM Grant, NM
Reserve	Apache, AZ Graham, AZ Greenlee, AZ Catron, NM
Gladden	La Paz, AZ Maricopa, AZ Mohave, AZ Yavapai, AZ
Bagdad	La Paz, AZ Mohave, AZ Yavapai, AZ
Sells	Maricopa, AZ Pinal, AZ Pima, AZ
Ruby/Fuzzy	Pima, AZ Santa Cruz, AZ

Legend: AZ = Arizona; MOA = Military Operations Area; NM = New Mexico.



Legend: AFB = Air Force Base; ANGB = Air National Guard Base; DAF = Department of the Air Force; MOA = Military Operations Area.

Figure 3.8-1 Counties Associated with MOAs

3.8.2.1 Population

Table 3.8-2 presents the 2010 and 2020 population information for Arizona and New Mexico, and the counties that are associated with the MOAs. The annual rate of population change between the two most recent census years is also provided. Within Arizona, most of the counties associated with the MOAs grew at a slower rate than Arizona as a whole. Five of the counties had a population reduction with La Paz County having the largest reduction at -2.37 percent per year. Maricopa County had the highest growth at 1.37 percent per year. All counties associated with the MOAs within New Mexico either declined in population or grew at a slower rate than New Mexico overall.

Table 3.8-2 Population and Population Trends, 2010–2020

	2010	2020	Annual Rate of Change 2010-2020
Arizona	**6,392,017**	**7,151,502**	**1.06%**
Apache County	71,518	66,021	-0.83%
Cochise County	131,346	125,447	-0.47%
Gila County	53,597	53,272	-0.06%
Graham County	37,220	38,533	0.34%
Greenlee County	8,437	9,563	1.18%
La Paz County	20,489	16,557	-2.37%
Maricopa County	3,817,117	4,420,568	1.37%
Mohave County	200,186	213,267	0.61%
Navajo County	107,449	106,717	-0.07%
Pima County	980,263	1,043,433	0.61%
Pinal County	375,770	425,264	1.16%
Santa Cruz County	47,420	47,669	0.05%
Yavapai County	211,033	236,209	1.07%
New Mexico	**2,059,179**	**2,117,522**	**0.28%**
Catron County	3,725	3,579	-0.41%
Grant County	29,514	28,185	-0.47%
Hidalgo County	4,894	4,178	-1.71%
Luna County	25,095	25,427	0.13%

Source: U.S. Census Bureau (USCB) 2010, 2020.

3.8.2.2 Housing Characteristics

Table 3.8-3 presents information on housing characteristics for Arizona and New Mexico, and the counties that are associated with the MOAs. La Paz County, Arizona and Catron County, New Mexico had the highest vacancy rates (45.2 percent and 43.2 percent, respectively), while Pima County, Arizona had the lowest vacancy rate (9.2 percent). Median housing values in all counties listed in Arizona were lower than Arizona overall, apart from Maricopa County ($304,700) and Yavapai County ($295,400). Median housing values in all counties listed in New Mexico were lower than New Mexico overall with the highest being Catron County ($175,200).

Table 3.8-3 Housing Characteristics

	Total Housing Units	Occupied Housing Units	Vacant Housing Units	Median Housing Value (dollars)
Arizona	**3,082,000**	**2,705,878**	**376,122**	**265,600**
Apache County	28,723	22,103	6,620	57,300
Cochise County	58,648	50,936	7,712	159,500
Gila County	32,373	22,312	10,061	190,700
Graham County	13,704	12,150	1,554	150,400
Greenlee County	4,389	3,634	755	92,600
La Paz County	13,457	7,370	6,087	104,300
Maricopa County	1,812,827	1,643,579	169,248	304,700
Mohave County	117,650	91,270	26,380	192,300
Navajo County	56,180	36,836	19,344	145,700
Pima County	470,132	427,021	43,111	217,700
Pinal County	172,878	146,663	26,215	218,400
Santa Cruz County	18,729	16,670	2,059	165,500
Yavapai County	121,154	104,425	16,729	295,400

	Total Housing Units	Occupied Housing Units	Vacant Housing Units	Median Housing Value (dollars)
New Mexico	**940,859**	**829,514**	**111,345**	**184,800**
Catron County	3,231	1,835	1,396	175,200
Grant County	14,584	12,269	2,315	125,000
Hidalgo County	2,190	1,714	476	94,400
Luna County	11,508	9,822	1,686	88,800

Source: USCB 2020; American Community Survey 2021.

3.8.2.3 Economic Characteristics

Table 3.8-4 presents information on economic characteristics for Arizona and New Mexico, and the counties that are associated with the MOAs. All counties in Arizona had a higher unemployment rate than Arizona overall apart from Greenlee (3.60 percent), Maricopa (5 percent), and Yavapai (5.40 percent) Counties. All counties in New Mexico had a lower unemployment rate than New Mexico overall (3.80 percent) except for Grant County (4.30 percent). Greenlee and Maricopa Counties had higher median household incomes than Arizona overall while no counties within the MOAs in New Mexico had a higher median household income than New Mexico overall. Greenlee, Maricopa, Pinal, and Yavapai Counties all had lower poverty rates than Arizonia overall. All counties within the MOAs in New Mexico had higher poverty rates than the state as a whole.

Table 3.8-4 Economic Characteristics

	Unemployment Rate	Median Household Income (dollars)	Families with Income Below Poverty Line
Arizona	**5.60%**	**65,913**	**9.50%**
Apache County	9%	34,788	27%
Cochise County	7.10%	55,077	9.70%
Gila County	7.30%	51,406	14.30%
Graham County	5.90%	57,105	15.50%
Greenlee County	3.60%	67,723	6.90%
La Paz County	7.70%	39,732	15.10%
Maricopa County	5%	72,944	8.50%
Mohave County	7.40%	49,738	10.90%
Navajo County	10.50%	46,126	19.60%
Pima County	6.30%	59,215	10.60%
Pinal County	6.40%	65,488	8.00%
Santa Cruz County	9.90%	45,089	18.40%
Yavapai County	5.40%	56,170	7.60%
New Mexico	**3.80%**	**54,020**	**13.80%**
Catron County	1.90%	37,623	14.40%
Grant County	4.30%	39,429	14.60%
Hidalgo County	2.90%	46,097	15.40%
Luna County	3.40%	33,914	22.40%

Legend: % = percent.
Source: USCB 2020; American Community Survey 2021.

Table 3.8-5 provides the top employment industries for the counties associated with the MOAs. The primary employment industries for Arizona and New Mexico counties associated with the MOAs are widely varied but primarily include educational services, health care and social assistance, and retail trade. Other notable primary industries include agriculture, forestry, fishing and hunting, and mining in Greenlee County, Arizona and Grant, Hidalgo, and Luna Counties, New Mexico; manufacturing in Catron County, New Mexico; and arts, entertainment, and recreation, and accommodation and food services in several counties in Arizona and New Mexico.

3.8.3 Environmental Consequences

In accordance with CEQ regulations, this section must evaluate the interrelatedness of the natural and physical environmental effects of the Proposed Action on the economic and social environment for present and future generations. The Proposed Action would not directly impact population levels, housing, or employment industries, but these socioeconomic characteristics may be indirectly impacted by noise and air emissions associated with aircraft training activities. The details of those impacts are provided in **Section 3.4**, *Noise* and **Section 3.5**, *Air Quality*.

Per FAA Order 1050.1F, there are no significance thresholds for socioeconomic impacts but factors to consider in the analysis include whether or not the Proposed Action or alternatives would have the potential to induce substantial economic growth; disrupt or divide the physical arrangement of an established community; cause extensive relocation when sufficient replacement housing is unavailable; cause extensive relocation of community businesses that would cause severe economic hardship; disrupt local traffic patterns and substantially reduce the level of service on roads; or produce a substantial change in the community tax base. None of these factors would be impacted by the Proposed Action or alternatives.

3.8.3.1 Alternative 1 – No Action

Under the No Action Alternative, the MOAs would continue to be used for current and projected future training and no modifications would occur . The MOAs throughout Arizona and a small portion of New Mexico have been in existence for decades and have been used for military aircraft training since the 1950s. Thus, the environmental impacts from this training are accounted for or represented in the current socioeconomic characteristics (population, housing, and economic/employment) described in **Section 3.8.2**. The No Action Alternative would not change the population, housing, or economic trends that exist currently in the counties associated with the MOAs.

3.8.3.2 Alternative 2 – Proposed Action

The analysis provided in **Section 3.5**, *Air Quality,* indicates a very minor increase in air emissions from the aircraft operations associated with the Proposed Action. None of the increases would exceed defined thresholds or affect the attainment status for any county. Thus, the proposed air emissions are not expected to interrelate or have indirect impacts to population, housing, or economic characteristics in the region.

Table 3.8-5 Percentage of Total Employees by Industry

	Agriculture, forestry, fishing and hunting, and mining	Construction	Manufacturing	Wholesale trade	Retail trade	Transportation and warehousing, utilities	Information	Finance and insurance, and real estate and rental and leasing	Professional, scientific, and management, and administrative and waste management services	Educational services, and health care and social assistance	Arts, entertainment, and recreation, and accommodation and food services	Other services, except public administration	Public administration
Arizona	1.2%	7.3%	7.2%	2.2%	12.0%	5.6%	1.8%	8.7%	12.5%	22.1%	10.0%	4.6%	4.8%
Apache County	2.7%	9.1%	2.1%	0.3%	8.6%	7.7%	1.3%	2.8%	3.6%	41.1%	8.4%	1.6%	10.8%
Cochise County	3.1%	6.5%	4.0%	1.0%	10.9%	5.2%	1.5%	4.1%	13.1%	21.0%	8.9%	4.1%	16.7%
Gila County	8.6%	8.3%	3.7%	1.5%	11.0%	4.8%	1.1%	4.3%	6.3%	25.8%	13.6%	3.2%	7.8%
Graham County	11.5%	10.3%	4.0%	2.0%	13.2%	4.3%	0.7%	3.9%	6.1%	22.4%	10.6%	5.0%	6.0%
Greenlee County	37.3%	7.5%	3.2%	0.5%	8.1%	1.3%	0.0%	3.4%	7.3%	17.0%	6.4%	4.7%	3.3%
La Paz County	10.0%	7.7%	3.7%	2.5%	12.3%	5.7%	0.8%	4.0%	5.6%	16.4%	16.3%	2.2%	12.8%
Maricopa County	0.5%	7.5%	7.6%	2.5%	11.9%	5.8%	1.9%	10.4%	13.5%	20.7%	9.4%	4.5%	3.8%
Mohave County	1.1%	7.8%	5.5%	1.5%	13.2%	6.5%	1.5%	5.9%	7.7%	22.1%	16.3%	4.8%	6.1%
Navajo County	2.4%	9.0%	2.3%	1.3%	12.4%	5.8%	1.0%	3.5%	4.8%	33.7%	10.9%	3.9%	8.9%
Pima County	1.0%	6.2%	6.8%	1.8%	11.6%	5.0%	1.6%	5.9%	12.7%	25.9%	10.7%	4.9%	6.0%
Pinal County	2.7%	7.4%	8.8%	1.8%	12.9%	6.1%	1.7%	6.8%	11.0%	21.0%	8.9%	4.2%	6.6%
Santa Cruz County	4.2%	6.9%	4.4%	7.1%	11.6%	11.9%	1.7%	3.4%	6.1%	21.4%	7.4%	4.7%	9.3%
Yavapai County	2.2%	9.2%	5.6%	1.6%	13.6%	4.0%	1.6%	5.2%	10.8%	23.2%	11.7%	6.5%	4.8%
New Mexico	4.0%	7.3%	4.1%	1.8%	11.0%	4.6%	1.3%	4.8%	12.0%	25.5%	10.4%	5.4%	7.7%
Catron County	6.9%	8.5%	24.2%	0.0%	12.3%	4.5%	0.6%	0.0%	3.2%	17%	14.2%	0.0%	8.6%
Grant County	11.5%	6.5%	2.2%	0.4%	12.4%	3.4%	1.2%	3.4%	5.1%	32.7%	12.3%	4.50%	4.3%
Hidalgo County	20.3%	4.4%	2.9%	0.2%	13.1%	7.1%	0.4%	1.2%	1.0%	29.0%	8.3%	3.0%	9.1%
Luna County	13.3%	8.7%	7.3%	0.9%	11.1%	6.7%	0.8%	2.8%	3.1%	23.8%	12.3%	3.0%	6.2%

Legend: % = percent.

The analysis provided in **Section 3.4**, *Noise*, indicates a modest increase in noise exposure associated with military aircraft training throughout the region. None of the results indicate noise exposure greater than 80 dB DNL in any location, thus noise-induced hearing loss is not a concern or potential impact. The noise exposure would not exceed 65 dB DNL in any area, indicating the noise is generally compatible with all land uses. In addition, none of the results indicate a "significant" noise impact as defined by FAA Order 1050.1F. The noise results for Tombstone A/B and the exclusion area, Morenci, Reserve, Sells, Ruby, and Fuzzy MOAs were all determined to be not significant or reportable according to FAA Order 1050.1F.

The areas where the change in noise exposure would be considered "reportable" according to FAA Order 1050.1F within noise sensitive areas include Jackal/Jackal Low MOA (Apache, Gila, Graham, Navajo, Pinal Counties in Arizona), Outlaw MOA (Gila, Maricopa, Pinal Counties in Arizona), and Gladden/Bagdad MOAs (La Paz, Maricopa, Mohave, Yavapai Counties in Arizona). The proposed Tombstone expansion area (Cochise County in Arizona, Hidalgo, Grant, and Luna Counties in New Mexico) and parts of the existing Tombstone C MOA (Cochise County in Arizona, Hidalgo County in New Mexico) would also notice an increase in noise exposure. Jackal, Outlaw, Bagdad, Gladden, and Tombstone are the MOAs that would have the greatest adjustment to the MOA floor, thus an increase in noise exposure would be expected.

There would not be a public health concern associated with the noise exposure, the primary concern would be an impact to property values and the use of and enjoyment of outdoor recreation areas and associated economic industries.

Housing

There are a number of factors that affect property values that make estimating impacts difficult. Factors directly related to the property, such as size, improvements, and location of the property, as well as current conditions in the real estate market, interest rates, and housing sales in the area, are more likely to have a direct impact on property values. Several studies have analyzed property values as they relate to military and civilian aircraft noise. In one study, a regression analysis of property values as they relate to aircraft noise at two military installations was conducted (Fidell et al. 1996). This study found that while aircraft noise from these installations may have had minor impacts on property values, it was difficult to quantify that impact. Other factors, such as the quality of the housing near the installations and the local real estate market, had a larger impact on property values. Therefore, the analysis was not able to predict the impact of aircraft noise on the property values of two comparable properties.

Another study examined and summarized the results of 33 studies that attempted to quantify the impact of noise on property values (Nelson 2003). It concluded that aircraft noise has the potential to adversely impact property values, specifically, property values could be discounted between 0.5 and 0.6 percent per decibel when compared to a similar property that is not affected by aircraft noise. Additionally, the data indicate that noise effects on property values increases for noise levels above 75 dB DNL. As illustrated in **Section 3.4**, the noise associated with training is lower than 75 dB DNL in all MOAs and much lower than noise associated with an active runway (i.e., an installation) which is the situation studied in these references. The noise exposure associated with aircraft training within MOAs is distributed across a vast area and no single location or county would be expected to receive a consistently high exposure to noise. Given the expected DNL values and the distribution of the training activity across such a large area, it would not be expected that the Proposed Action would have any quantifiable impacts to the existing housing values within the region.

Economic Impacts

The noise results do not indicate a significant impact nor would any of the areas have noise exposure at a level that would be considered incompatible with recreational land uses or any other land uses (greater than 65 dB DNL). Data concerning impacts to visitation to National Forests and National Parks was released in two Reports to Congress (USFS 1992; NPS 1994a). In the USFS study, wilderness visit enjoyment showed little relationship with annoyance due to the sound or sight of aircraft. In a similar NPS study, it was found that 2 to 3 percent of visitors can be expected to report "impact" from hearing or seeing aircraft. "Impact" was defined as: interfered with enjoyment; annoyed by hearing or seeing aircraft; or interfered with appreciation of natural quiet. While it is possible that noise could reduce visitation by some users, there is no way to predict the exact impact that the presence of military aircraft may have on a specific National Forest or National Park. Since the specific impact to visitation cannot be determined, the economic impact cannot be quantified. However, based on the USFS and NPS assessments, it is not expected that the presence of aircraft noise would have a significant impact to overall visitation nor the economic contributions associated with that visitation. All of the recreational areas in the ROI are currently exposed to military overflight with the exception of the Tombstone MOA expansion area. Military overflights are a common experience. As described in **Section 3.7**, the sound may be annoying or startling to a person recreating beneath the MOAs, may mask natural sounds like bird calls or rustling leaves, or temporarily interrupt outdoor conversation. This experience would not occur with any sort of regularity or be a repetitive situation in any location.

The primary employment industries for each of the counties associated with the MOA are not expected to be impacted by the Proposed Action. While retail trade and arts, entertainment, and recreation, and accommodation and food services are primary employment industries in many of the counties, the noise exposure from military aircraft is not expected to significantly change those industries. As discussed in **Section 3.6.3.2**, *Natural Resources*, the Proposed Action is not expected to have a significant impact on domestic animals or livestock. The noise from overflights may startle domestic animals, but detrimental harm is unlikely. Thus, the Proposed Action would not significantly impact ranching or livestock industries.

3.8.3.3 Alternative 3

The analysis provided in **Section 3.5**, *Air Quality*, indicates a very minor increase in air emissions from the aircraft operations associated with Alternative 3. None of the increases would exceed defined thresholds or affect the attainment status for any county. Thus, the proposed air emissions are not expected to interrelate or have indirect impacts to population, housing, or economic characteristics in the region.

The analysis provided in **Section 3.4**, *Noise*, indicates a modest increase in noise exposure associated with military aircraft training throughout the region under Alternative 3. The potential noise impacts would be similar in all areas described for Alternative 2 with the exception of the Tombstone MOA northern expansion. Under this alternative, the Tombstone MOA would not be expanded, thus there would be no new noise exposure in this area. The potential impacts to housing and economic characteristics would be the same as those described for Alternative 2. The noise exposure is not expected to have a quantifiable impact to housing values or impact the primary employment industries in the region.

3.8.3.4 Alternative 4

The potential socioeconomic impacts associated with Alternative 4 would be the same as those described for Alternative 2 – Proposed Action.

3.8.4 Cumulative Impacts

Baseline socioeconomic conditions are influenced by many factors including those activities identified in **Appendix G**. Land management activities on public lands, such as cattle grazing, extractive industry, and recreation contribute to local economies directly and indirectly through creating jobs and influencing spending. The effects of past and ongoing actions are captured in the baseline socioeconomic conditions. The Proposed Action and alternatives would not be expected to affect population, housing, or employment or to contribute to significant cumulative effects.

3.8.5 Mitigations

There are no significant impacts associated with socioeconomics, thus no mitigation is required.

3.9 ENVIRONMENTAL JUSTICE

3.9.1 Resource Definition and Regulatory Framework

EO 12898, *Federal Actions to Address Environmental Justice in Minority Populations and Low-Income Populations*, states that a Federal agency "shall make achieving environmental justice part of its mission by identifying and addressing, as appropriate, disproportionately high and adverse human health or environmental effects of its programs, policies, and activities on minority populations and low-income populations."

EO 13045, *Protection of Children from Environmental Health Risks and Safety Risks*, was issued in 1997 to identify and address issues that affect the protection of children. Children may suffer disproportionately more environmental health and safety risks than adults because of various factors: children's neurological, digestive, immunological, and other bodily systems are still developing; children eat more food, drink more fluids, and breathe more air in proportion to their body weight than adults; children's behavior patterns may make them more susceptible to accidents because they are less able to protect themselves; and children's size and weight may diminish the protection they receive from standard safety features.

EO 14096, *Revitalizing Our Nation's Commitment to Environmental Justice for All,* was issued in 2023 to build on the foundation of EO 12898 by charging federal agencies with building upon and strengthening commitments to deliver environmental justice to all communities and requires the development of Strategic Plans for doing so that include performance and accountability measures.

3.9.2 Affected Environment

3.9.2.1 Minority and Low-Income Populations

This section identifies minority or low-income populations that could potentially be affected by the Proposed Action. For the purpose of this evaluation, minority refers to people who identified themselves in the U.S. Census as Black or African American, Asian, or Pacific Islander, American Indian or Alaskan Native, other non-White races, or as being of Hispanic or Latino origin. Persons of Hispanic and Latino origin may be of any race (CEQ 1997). The CEQ identifies these groups as minority populations when either (1) the minority population of the affected area exceeds 50 percent, or (2) the minority population percentage in the affected area is meaningfully greater than the minority population percentage in the general population or appropriate unit of geographical analysis. While not defined by the CEQ, the term "meaningfully greater" for the purposes of this EIS has been interpreted to mean that the total minority population is 20 percent or more than the minority population of the geographic region of comparison. Poverty (i.e., low-income) status is determined by dollar-value thresholds that vary by family size and composition. If a family's total income is less than the dollar-value of the appropriate threshold, then that family and every individual in it are considered to be in poverty.

Table 3.9-1 provides the total population, total minority, percentage minority, total low-income population, and low-income percentage for the counties affected by the Proposed Action. Minority and low-income populations are then compared to their respective state. The minority population within the ROI exceeds 50 percent in 4 of the 17 counties. Eight of the 17 counties have low-income populations that exceed 20 percent. Refer to **Table 3.8-1 and Figure 3.8-1** for a list of counties associated with each MOA and a figure showing those boundaries.

Table 3.9-1 also provides the total American Indian population for each county and the states as a whole. In addition to being considered as part of the disadvantaged communities in the environmental justice analysis, these populations are also considered in the government-to-government consultations (see **Section 3.10**, *Cultural Resources*). For American Indian populations that are tribal members, there are additional opportunities to address and mitigate potential impacts from the Proposed Action through that consultation process. **Table 3.9-1** further shows the portion of the county population that identified as American Indian race either alone or a part of multi-race cohort. In La Paz and Mohave Counties, American Indians comprise more of the minority population than the state overall. In Apache and Navajo Counties, which include the Navajo Reservation, most of the minority population is American Indian. The DAF is consulting with 30 Native American Tribes and Pueblos for this Proposed Action, see **Section 3.10.2** for a complete list.

Table 3.9-1 Population and Race

	Total Population	Minority Population	Percent Minority	Low-Income Population	Percent Low-Income	American Indian Population	Percent of Minority Identified as American Indian
Arizona	**7,151,502**	**2,829,165**	**39.56%**	**934,911**	**13.07%**	**349,024**	**12.34%**
Apache County	66,021	51,148	77.47%[1]	22,089	33.46%[1]	47,455	92.78%
Cochise County	125,447	43,714	34.85%	16,872	13.45%	2,838	6.49%
Gila County	53,272	17,368	32.60%	10,329	19.39%	10,090	58.10%
Graham County	38,533	13,490	35.01%	6,940	18.01%	6,057	44.90%
Greenlee County	9,563	2,979	31.15%	1,097	11.47%	612	20.54%
La Paz County	16,557	6,785	40.98%	3,326	20.09%[1]	2,777	40.93%
Maricopa County	4,420,568	1,775,056	40.15%	518,951	11.74%	116,320	6.55%
Mohave County	213,267	43,535	20.41%	33,239	15.59%	8,304	19.07%
Navajo County	106,717	58,287	54.62%[1]	26,478	24.81%[1]	48,559	83.31%
Pima County	1,043,433	410,051	39.30%	152,356	14.60%	35,273	8.60%

	Total Population	Minority Population	Percent Minority	Low-Income Population	Percent Low-Income	American Indian Population	Percent of Minority Identified as American Indian
Pinal County	425,264	156,006	36.68%	45,280	10.65%	30,089	19.29%
Santa Cruz County	47,669	31,740	66.58%[1]	10,216	21.43%[1]	204	0.06%
Yavapai County	236,209	43,702	18.50%	28,563	12.09%	9,840	22.52%
New Mexico	**2,117,522**	**1,038,585**	**49.05%**	**378,896**	**17.89%**	**214,718**	**20.67%**
Catron County	3,579	618	17.27%	794	22.18%[1]	111	17.96%
Grant County	28,185	9,919	35.19%	6,023	21.37%[1]	581	5.86%
Hidalgo County	4,178	1,523	36.45%	911	21.80%[1]	36	2.36%
Luna County	25,427	12,630	49.67%[1]	6,542	25.73%[1]	370	2.93%

Note: Minority population calculated by subtracting the non-Hispanic white only population total from total population values. American Indian population includes all race cohorts that include American Indian such as two races White and American Indian.
[1]Minority populations that exceed 50 percent and low-income populations that exceed 20 percent.
Legend: % = percent.
Source: USCB 2020.

3.9.2.2 Protection of Children

This section identifies populations under the age of 18 that could potentially be affected by the Proposed Action. As shown in **Table 3.9-2**, the percentage of the population estimated to be under age 18 in Arizona was 18.8 percent and in New Mexico it was 24.5 percent. Apache County, Arizona and Luna County, New Mexico had the largest percentages at 45.0 percent and 37.4 percent, respectively.

Table 3.9-2 Percentage of Residents under Age 18

	Total Population	Percentage Under 18
Arizona	**7,151,502**	**18.8%**
Apache County	66,021	45.0%
Cochise County	125,447	20.0%
Gila County	53,272	32.2%
Graham County	38,533	26.0%
Greenlee County	9,563	13.0%
La Paz County	16,557	27.4%
Maricopa County	4,420,568	17.1%
Mohave County	213,267	25.7%
Navajo County	106,717	34.3%
Pima County	1,043,433	20.2%
Pinal County	425,264	15.2%
Santa Cruz County	47,669	27.5%
Yavapai County	236,209	17.1%
New Mexico	**2,117,522**	**24.5%**
Catron County	3,579	29.5%
Grant County	28,185	35.4%
Hidalgo County	4,178	34.6%
Luna County	25,427	37.4%

Note: Calculated by subtracting percentage of population 18 years and older from 100.
Legend: % = percent.
Source: USCB 2020.

3.9.3 Environmental Consequences

The analysis of environmental justice considered the minority and low-income populations and children underlying the MOAs. Similar to **Section 3.8**, *Socioeconomics*, noise and air emissions have the potential to affect minority and low-income populations, and children. In addition, government-to-government consultations associated with the Proposed Action and alternatives are occurring concurrently with this EIS to identify any other Environmental Justice concerns specific to Native American Tribes.

3.9.3.1 Alternative 1 – No Action

Under the No Action Alternative, the MOAs would continue to be used for current and projected future training and no modifications would occur . The environmental impacts from this training are accounted for or represented in the current Environmental Justice characteristics described in **Section 3.9.2**. The analysis provided in **Section 3.4**, *Noise*, illustrates that the noise exposure from military aircraft does not exceed 80 dB DNL in any location, thus noise induced hearing loss is not a concern or potential impact. The noise exposure would also not exceed 65 dB DNL in any area, indicating the noise is generally compatible with all land uses. The noise levels are also well below 75 dB DNL, the level at which housing values could be affected (Nelson 2003). Since there are no significant impacts associated with noise, there would not be any disproportionate impacts to environmental justice populations or children.

3.9.3.2 Alternative 2 – Proposed Action

The study area for environmental justice analysis is defined as the communities beneath the MOAs. The analysis provided in **Section 3.5**, *Air Quality*, indicates a very minor increase in air emissions from the aircraft operations associated with the Proposed Action. None of the increases would exceed defined thresholds or affect the attainment status for any county. Since there are no significant impacts associated with air quality, there would not be any disproportionate impacts to environmental justice populations or children.

The analysis provided in **Section 3.4**, *Noise*, indicates a modest increase in noise exposure associated with military aircraft training throughout the region. None of the results indicate noise exposure greater than 80 dB DNL in any location, thus noise induced hearing loss is not a concern or potential impact. The noise levels are also well below 75 dB DNL, the level at which housing values could be affected (Nelson 2003). The noise exposure would not exceed 65 dB DNL in any area, indicating the noise is generally compatible with all land uses. The noise also does not exceed the threshold, 60 dB Equivalent Sound Level (L_{eq}), that indicates a concern for classroom speech interference (DNWG 2013c). The metric L_{eq} is essentially DNL without the nighttime penalty, thus DNL is always higher than L_{eq}. Since 60 dB DNL is not exceeded in any location there is not a concern for classroom speech interference. None of the results indicate a “significant” noise impact as defined by FAA. The noise results for Tombstone A/B and the exclusion area, Morenci, Reserve, Sells, Ruby, and Fuzzy MOAs were all determined to be not significant or reportable according to FAA Order 1050.1F.

The areas where the change in noise exposure would be considered “reportable” according to FAA Order 1050.1F within noise sensitive areas include Jackal/Jackal Low MOA (Apache, Gila, Graham, Navajo, Pinal Counties in Arizona), Outlaw MOA (Gila, Maricopa, Pinal Counties in Arizona), and Gladden/Bagdad MOAs (La Paz, Maricopa, Mohave, Yavapai Counties in Arizona). The proposed expansion area for Tombstone MOA (Cochise County in Arizona, Hidalgo, Grant, and Luna Counties in New Mexico) and parts of the existing Tombstone C MOA (Cochise County in Arizona, Hidalgo County in New Mexico) would also notice an increase in noise exposure. Apache County, Arizona and Luna County, New Mexico have a minority population that exceeds 50 percent. Hidalgo, Grant, and Luna Counties, New Mexico have low-income populations that exceed 20 percent.

The proposed training would be spread across a vast area and impact all counties and areas beneath the MOAs equally, as it does currently. The training within the MOAs is not expected to occur in any one location on a repetitive basis; therefore, no population would be exposed to a disproportionate number of overflights and the associated impacts from those overflights. While minority and low-income populations do exist beneath the MOAs, there are no predicted significant impacts nor would any of the potential impacts cause a disproportionately high and adverse human health or environmental effect to environmental justice populations or children.

3.9.3.3 Alternative 3

Alternative 3 has the same proposed modifications as Alternative 2, except there would be no horizontal changes to Tombstone MOA/ATCAA. The air emissions and noise exposure are similar as those presented in Alternative 2. Without the proposed expansion of Tombstone MOA, Luna County, New Mexico would not be included in the ROI and would not be impacted. All other environmental justice conclusions would remain the same as presented in Alternative 2. Implementation of Alternative 3 would not cause disproportionate impacts on any environmental justice populations or children.

3.9.3.4 Alternative 4

Alternative 4 has the same proposed changes as Alternative 2, except that supersonic flight would be authorized down to 10,000 feet AGL (instead of 5,000 feet AGL) in Tombstone, Outlaw, Jackal, Morenci, and Reserve MOAs. The noise associated with proposed operations in the MOAs and thus the potential impacts to environmental justice populations beneath these MOAs would be less than in Alternative 2. Implementation of Alternative 4 would not cause disproportionate impacts on any environmental justice populations or children.

3.9.4 Cumulative Impacts

The Proposed Action and alternatives would not result in significant impacts to any resources that would adversely impact the health or environment of minority or low-income populations or children living beneath existing or proposed airspace. The past and ongoing activities identified in **Appendix G** contribute to the baseline conditions against which the impacts of the Proposed Action and alternatives were compared. No ongoing or future activities have been identified that would create impacts that would disproportionately or adversely affect minority or low-income populations or children.

3.9.5 Mitigations

There are no significant impacts associated with environmental justice, thus no mitigations are required. Any environmental justice concerns identified during Government-to-Government consultation will be discussed in **Section 3.10.5**.

3.10 CULTURAL RESOURCES

3.10.1 Resource Definition and Regulatory Framework

Cultural resources can be broadly defined as pre-contact and post-contact historic sites and districts; structures; artifacts; features that display evidence of human activity; and landscapes and features that play a fundamental role in a specific community's identity, beliefs, or value system. Cultural resources can be divided into three major categories: archaeological resources (pre-contact and post-contact), architectural resources, and sacred sites.

Archaeological resources are locations where human activity measurably altered the earth or left deposits of physical remains (e.g., tools, projectile points, or bottles). "Pre-contact" refers to resources that predate contact with Europeans. These resources can range from a scatter composed of a few artifacts to village sites and rock art. "Post-contact" refers to resources that postdate contact with Europeans. Archaeological resources can include campsites, roads, fences, trails, dumps, battlegrounds, mines, and a variety of other features.

Architectural resources include standing buildings, dams, canals, bridges, and other structures of historic or aesthetic significance. Architectural resources generally must be more than 50 years old to be considered for protection under existing cultural resource laws. However, more recent structures, such as Cold War-era military buildings, may warrant protection if they have exceptional characteristics and the potential to be historically significant structures.

Sacred sites are "any specific, discrete, narrowly delineated location that is identified by an Indian tribe, or Indian individual determined to be an appropriately authoritative representative of an Indian religion, as sacred by virtue of its established religious significance to, or ceremonial use by, an Indian religion, provided that the tribe or appropriately authoritative representative of an Indian religion has informed the agency of the existence of such a site" (EO 13007).

Historic properties considered to be significant, known or unknown, warrant consideration with regards to adverse impacts resulting from a proposed action. To be considered significant, archaeological or architectural resources must meet one or more criteria as defined in 36 CFR 60.4 for inclusion in the National Register of Historic Places (NRHP). The quality of significance in American history, architecture, archaeology, engineering, and culture is present in districts, sites, buildings, structures, and objects that possess integrity of location, design, setting, materials, workmanship, feeling, and association, and:

a) that are associated with events that have made a significant contribution to the broad patterns of our history; or

b) that are associated with the lives of persons significant in our past; or

c) that embody the distinctive characteristics of a type, period, or method of construction, or that represent the work of a master, or that possess high artistic values, or that represent a significant and distinguishable entity whose components may lack individual distinction; or

d) that have yielded, or may be likely to yield, information important in prehistory or history.

Traditional cultural properties are a type of historic property and are associated with cultural practices and beliefs of a living community that are (a) rooted in the community's history and (b) important to maintaining the continuing cultural identity of the community (NPS 1998). Traditional cultural properties can include archaeological resources, buildings, neighborhoods, prominent topographic features, habitats, plants, animals, and minerals that Native Americans or other groups consider essential for the continuance of traditional cultures.

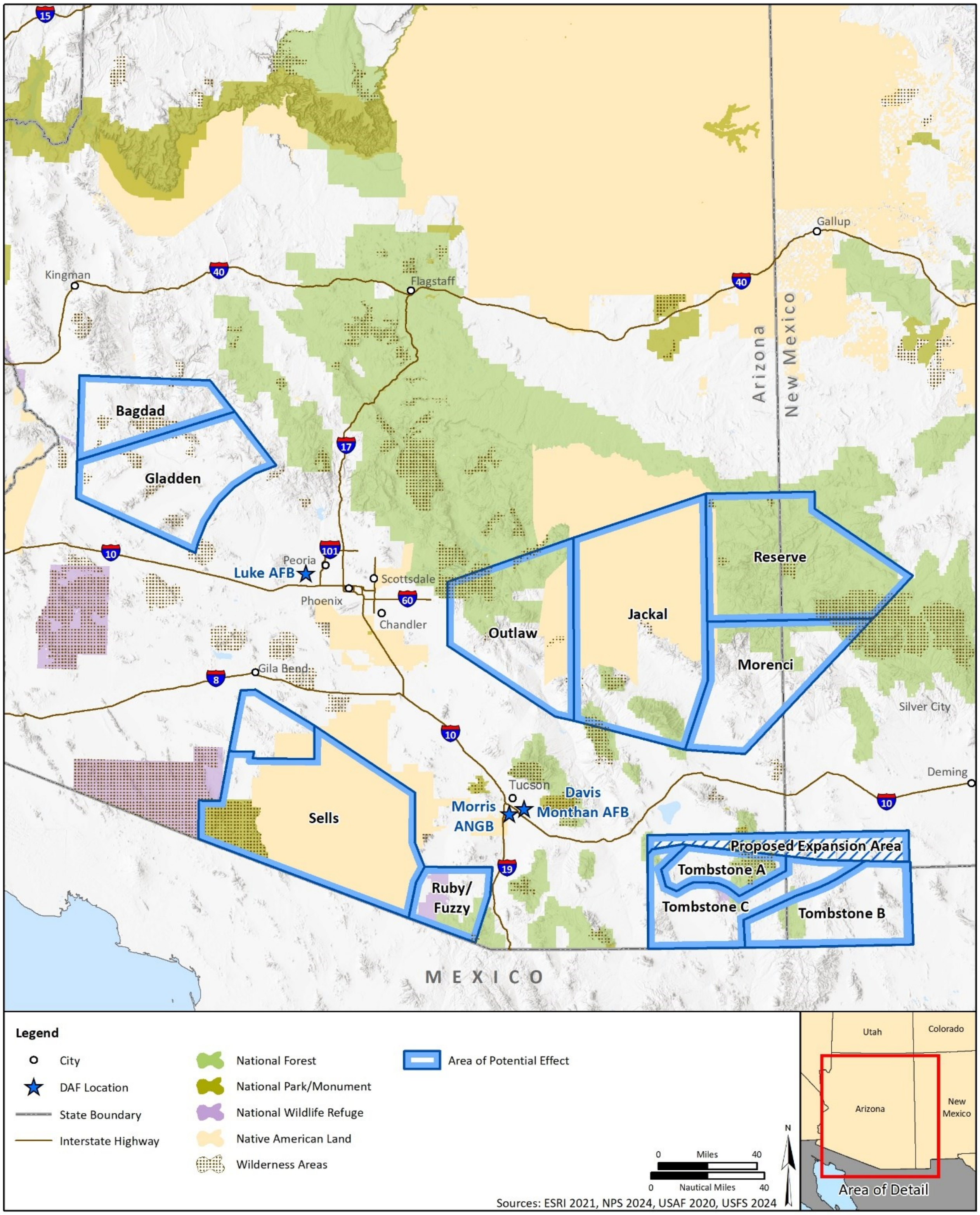
Several Federal laws and regulations have been established to manage cultural resources, including the NHPA (54 USC 300101 et seq.), the Archaeological and Historic Preservation Act (6 USC 469-469c), the American Indian Religious Freedom Act (42 USC 1996), the Archaeological Resources Protection Act (16 USC 470aa-470mm), and the Native American Graves Protection and Repatriation Act (25 USC 300101 et seq.).

EO 13175, *Consultation and Coordination with Indian Tribal Governments*, of November 6, 2000, charges all executive departments and federal agencies with engaging in regular, meaningful, and robust consultation with Tribal Nation officials in the development of Federal policies that have Tribal implications. On November 30, 2022, President Biden released a *Memorandum on Uniform Standards for Tribal Consultation* which established uniform minimum standards to be implemented across all Federal agencies regarding how Tribal consultations are to be conducted. This memorandum was designed to respond to the input received from Tribal Nations regarding Tribal consultation, improve and streamline the consultation process for both Tribal Nations and Federal participants, and ensure more consistency in how agencies initiate, provide notice for, conduct, record, and report on Tribal consultations. Additionally, DoD Instruction 4710.02, *DoD Interactions With Federally Recognized Tribes,* DAFI 90-2002, *Interactions with Federally Recognized Tribes,* and AFMAN 32-7003, *Environmental Conservation,* emphasize the importance of respecting and consulting with Tribal governments on a government-to-government basis in recognition of their sovereignty as a nation.

Section 106 of the NHPA requires all Federal agencies to consider the effects of their undertakings on historic properties and seek to avoid, minimize, or mitigate adverse effects to these properties (36 CFR 800.1(a)). Section 106 also requires agencies to consult with Federally recognized Tribal Nations that attach religious and cultural significance to historic properties that may be affected by an undertaking. In addition, agencies must involve stakeholders including representatives of local governments, individuals and organizations with a demonstrated interest in the undertaking, and the public. Davis-Monthan AFB, Luke AFB, and Morris ANGB consult with Federally recognized tribes on a recurring basis, to include non-scheduled consultations when required.

3.10.2 Affected Environment

The affected environment for cultural resources is based on the establishment of the Area of Potential Effects (APE) of an undertaking, through consultation with the Arizona and New Mexico SHPOs, Tribal Nations, NPS, and other consulting parties. An APE is defined in 36 CFR part 800.16(d) as “the geographic area or areas within which an undertaking may directly or indirectly cause changes in the character or use of historic properties, if any such properties exist.” The APE, and therefore the affected environment for this project, encompasses the areas affected by airspace expansion, the noise generated, change in visual setting, and release of chaff and flares underlying the MOAs and ATCAAs (**Figure 3.10-1**).



Legend: AFB = Air Force Base; ANGB = Air National Guard Base; DAF = Department of the Air Force.

Figure 3.10-1 Area of Potential Effects for Cultural Resources

Information on cultural resources within the affected environment was derived from conducting background research to identify NRHP and the State Register of Historic Places properties beneath the affected airspace; national historic landmarks; national battlefields; national historic trails; or any cultural landscapes, recorded within the same area; and American Indian Reservations, sacred areas, or traditional use areas.

The DAF has determined that the Proposed Action is an undertaking as defined in 36 CFR Section 800.16(y) and in accordance with Section 306108 (also known as Section 106) of the NHPA and its implementing regulations at 36 CFR Part 800, the DAF is consulting with the Arizona and New Mexico SHPOs. The DAF informed both SHPOs via a letter dated January 10, 2022, with a notice of intent that an EIS was being prepared to evaluate the potential environmental impacts of optimizing the SUA available to support DAF missions in Arizona. The letter requested their office to consult regarding the Proposed Action. The Arizona SHPO responded on February 7, 2022, stating they had no comments on the Proposed Action and they looked forward to the Section 106 consultation for the project. The New Mexico SHPO responded on January 28, 2022, stating they look forward to working with the DAF during the Section 106 consultation for the project. A letter dated June 27, 2024 was provided to Arizona and New Mexico SHPOs requesting concurrence on the APE and the identification of historic properties. All correspondence associated with consultation with the SHPOs is provided in **Appendix N**. In accordance with Section 106 of the NHPA and its implementing regulations at 36 CFR section 800.4, the DAF will continue consultation with the Arizona and New Mexico SHPOs by providing the determination of effects of the undertaking on historic properties (36 CFR section 800.5) concurrent with the release of the Draft EIS.

In accordance with the NEPA process and Section 106 of the NHPA and its implementing regulations at 36 CFR Part 800, the DAF initiated government-to-government consultation with Tribal Nations concurrent with the public scoping process. Letters were sent via email (the preferred method of communication) on January 20, 2022, to 30 Tribal Nations and Pueblos that are located beneath or near the affected airspace or may have traditional ties to these lands. These Tribal Nations and Pueblos include: Ak-Chin Indian Community, Chemehuevi Indian Tribe, Cocopah Indian Tribe, Colorado River Indian Tribe, Fort McDowell Yavapai Nation, Fort Mojave Indian Tribe, Fort Sill Apache Tribe of Oklahoma, Fort Yuma Quechan Indian Tribe, Gila River Indian Community, Havasupai Tribe, Hopi Tribe, Hualapai Tribe, Jicarilla Apache Nation of New Mexico, Kaibab Band of Paiute Indians, Kickapoo Tribe of Oklahoma, Mescalero Apache Tribe, Moapa Band of Paiute Indians, Navajo Nation, Paiute Indian Tribe of Utah (Cedar Band of Paiutes, Kanosh Band of Paiutes, Koosharem Band of Paiutes, Indian Peaks Band of Paiutes, and Shivwits Band of Paiutes), Pascua Yaqui Tribe, Pueblo of Zuni, Salt River Pima-Maricopa Indian Community, San Carlos Apache Tribe, San Juan Southern Paiute Tribe, Tohono O’odham Nation, Tonto Apache Tribe, Ute Mountain Ute Tribe, White Mountain Apache Tribe, Yavapai-Apache Nation, and the Yavapai-Prescott Indian Tribe.

See **Appendix N** for all Section 106 and government-to-government correspondence completed to date. Multiple attempts were made via email, hard copy mail, and phone calls to 19 Tribal Nations and Pueblos that did not engage during the scoping process (see **Appendix N**). The identification of traditional cultural properties or areas of significance that have been identified during government-to-government consultations have been incorporated into the appropriate MOA sections within **Section 3.10.2**, *Affected Environment*, to ensure full consideration in this EIS. Below includes a summary of the engagement with the Tribal Nations that has occurred up to the release of the Draft EIS:

- The Moapa Band of Paiute Indians expressed their concern regarding noise pollution disturbing the pathway songscape of the "Salt Song Trail."
- The San Carlos Apache Tribe sent a letter stating their concerns of fire risk and requested formal consultation with the DAF.
- Multiple emails were exchanged between DAF and the Tohono O'odham Nation with a virtual meeting being held on June 23, 2022, followed by an in-person meeting hosted by Brigadier General Kreuder at Luke AFB with several Tohono O'odham Nation representatives in attendance.
- The White Mountain Apache Tribe requested a meeting with the DAF which was held on August 4, 2022. During the meeting, the White Mountain Apache Tribe discussed noise sensitive areas for avoidance that included eagle nesting areas. The DAF provided a map to the Tribe and representatives so they could review and provide updates on these areas. The Tribe also discussed avoidance for several populated areas, and they identified Mount Baldy as a traditional cultural property.
- The Gila River Indian Community and the Yavapai-Prescott Indian Tribe responded they had no concerns and look forward to reviewing the EIS as it becomes available for review.
- The Yavapai-Apache Nation stated they had no issues and they would defer the government-to-government consultation to the White Mountain and San Carlos Apache Tribes.
- The Fort Yuma Quechan Indian Tribe responded that they had no comment on the project and they would defer to the more local tribes regarding the project.
- Davis-Monthan AFB hosted its annual Tribal Summit in November 2023 and provided an update on the project to representatives in attendance. Tribes in attendance associated with this EIS included: Chemehuevi Indian Tribe, Cocopah Indian Tribe, Hopi Tribe, Hualapai Tribe, Kaibab Band of Paiute Indians, Kickapoo Tribe of Oklahoma, Mescalero Apache Tribe, Moapa Band of Paiute Indians, Pascua Yaqui Tribe, Fort Yuma Quechan Indian Tribe, Salt River Pima-Maricopa Indian Community, San Carlos Apache Tribe, San Juan Southern Paiute Tribe, and Tohono O'odham Nation.

The DAF will continue government-to-government consultation with all 30 Tribal Nations and Pueblos through the end of the project and before implementation of the Proposed Action or any action alternative.

3.10.2.1 Tombstone MOA/ATCAA

Archaeological and Architectural Resources

There are two archaeological sites and 27 architectural sites listed in the NRHP that are located beneath the existing and proposed Tombstone MOA/ATCAA (**Appendix M**). The archaeological sites consist of a cemetery and the location where Geronimo surrendered (NPS 2022a). The architectural sites consist of three houses, six historic districts, one hotel, two churches, one airport, one underpass, one theatre, two USFS lookout cabins/lookout complex, three USFS ranger stations, one Young Men's Christian Association building, one railroad passenger depot, three buildings associated with border patrol, one clubhouse, and one general store (NPS 2022a).

Three National Historic Landmarks are located beneath the existing Tombstone MOA/ATCAA: Phelps Dodge General Office Building, San Bernardino Ranch, and Double Adobe Site (NPS 2022b). The Phelps Dodge General Building was the headquarters for the Phelps Dodge mining company between 1896 to 1961 and currently houses the Bisbee Mining and Historical Museum (Landmark Hunter 2021).

The San Bernardino Ranch is the site of two historic cattle ranches that straddled the U.S. and Mexico border (NPS 2021a). The Double Adobe Site is a Paleoindian site with mammoth remains and stone tools that is located in the Whitewater Draw area in southern Arizona.

No National Historic Monuments, National Historic Trails or National Historic Battlefields are located under the existing and proposed Tombstone MOA/ATCAA (NPS 2022c, 2022d, 2023a). The Continental Divide National Scenic Trail is not listed in the NRHP, see **Section 3.7.2.1**, *Tombstone MOA*, for a discussion of the trail and its recreational importance.

There are no sites listed in the Arizona State Register of Historic Places or in the New Mexico State Register of Historic Places located beneath the existing and proposed Tombstone MOAs/ATCAAs (Arizona State Parks 2023; New Mexico Historic Preservation Division 2021).

Traditional Cultural Properties

Government-to-government consultation with Federally recognized Tribes and Pueblos to date have not identified any traditional cultural properties associated with the lands under the existing or proposed Tombstone MOA/ATCAA. See **Appendix N** for all Section 106 and government-to-government correspondence.

3.10.2.2 Outlaw and Jackal MOAs/ATCAAs

Archaeological and Architectural Resources

There are two archaeological sites and 66 architectural sites listed in the NRHP beneath the existing Outlaw and Jackal MOAs/ATCAAs (**Appendix M**). The archaeological sites consists of a prehistoric Salado masonry pueblo and a holy cross (NPS 2022a). The architectural sites consist of 1 dam, 12 bridges, 3 hotels, 2 schools, 4 churches, 4 historic districts, 1 bank, 3 courthouses, 4 buildings, 1 railroad depot, 1 pueblo, 22 houses, 3 USFS lookout towers/lookout complex, 1 USFS ranger station, 1 mine rescue station, 1 depression-era USFS work station, 1 arboretum, and charcoal ovens (NPS 2022a).

Two Arizona State Register of Historic Places sites, Freeman Homestead Ruins and Lime Kilns, are located within the Saguaro National Park beneath the existing Outlaw and Jackal MOAs/ATCAAs (Arizona State Parks 2023).

Three National Historic Landmarks are located beneath the existing Outlaw and Jackal MOAs/ATCAAs, Kinishba Ruins, Fort Apache and Theodore Roosevelt School, and Sierra Bonita Ranch (NPS 2022b). The Kinishba Ruins is located west of Fort Apache Indian Reservation and consists of nine masonry buildings constructed between 1250 and 1350 A.D. by the pre-Columbian Mogollon culture (NPS 2023a). Fort Apache was a crucial link in the chain of forts supporting the U.S. military effort in the southwest. It was later used as a recruitment center for young Native American men that enlisted to serve as translators and de facto military police and was later used for the African American regiments that served on the western frontier. In the 1920s, the Fort Apache was transformed into the Theodore Roosevelt School, which was a boarding and day school run by the Bureau of Indian Affairs (Erickson et al. 2024). Sierra Bonita Ranch was the first permanent American cattle ranch in Arizona (NPS 2021b).

No National Historic trails or National Historic Battlefields are located under the Outlaw and Jackal MOAs/ATCAAs (NPS 2022d, 2023b).

Traditional Cultural Properties

The Chi'chil Bildagoteel (Oak Flat) Historic District Traditional Cultural Property is located on the Tonto National Forest beneath the Outlaw and Jackal MOAs/ATCAAs. Chi'chil Bildagoteel is a sacred site and ancestral homeland to the Western Apache Indians (Nez 2014).

Government-to-government consultation with Federally recognized Tribes and Pueblos to date have not identified any other traditional cultural properties associated with the lands under the Outlaw and Jackal MOAs/ATCAAs (consultation correspondence is located in **Appendix N**).

3.10.2.3 Gladden and Bagdad MOAs/ATCAAs

Archaeological and Architectural Resources

There is one archaeological site and three architectural sites listed in the NRHP beneath the Gladden and Bagdad MOAs/ATCAAs (**Appendix M**). The archaeological site consists of the ruins of a U.S. Army post and the architectural sites consist of one house, one school, and an observatory (NPS 2022a).

There are no sites listed in the Arizona State Register of Historic Places located beneath the existing Gladden and Bagdad MOAs/ATCAAs (Arizona State Parks 2023).

No National Historic Landmarks, National Historic Monuments, National Historic Trails, or National Historic Battlefields are located under the existing Gladden and Bagdad MOAs/ATCAAs (NPS 2022b, 2022c, 2022d, 2023b).

Traditional Cultural Properties

During government-to-government consultation with Federally recognized Tribes and Pueblos, the Moapa Band of Paiutes identified the "Salt Song Trail," a cultural landscape, located on lands under the existing Gladden and Bagdad MOAs/ATCAAs (consultation correspondence is located in **Appendix N**). The Salt Song Trail is described as a Songscape (Cry Song) of Traditional Ecological Knowledge of the afterlife journey trail going through Southern Nevada, Southern Utah, Northern Arizona, and Southern California. The Salt Song Trail is a cultural landscape that is an important part of their heritage, cultural, traditions, and holistic approach to the Southern Paiutes still practicing songs today and includes all of these lands (Native Land 2023).

3.10.2.4 Morenci MOA/ATCAA

Archaeological and Architectural Resources

There is one archaeological site and eight architectural sites listed in the NRHP beneath the existing Morenci MOA/ATCAA in Arizona (**Appendix M**). The archaeological site consists of the ruins of a U.S. Army post and the architectural sites consist of two houses, three bridges, one road overpass, one building, and one historic district (NPS 2022a). There are no NRHP-listed sites beneath the existing Morenci MOA/ATCAA in New Mexico (NPS 2022a).

There are no sites listed in the Arizona State Register of Historic Places (Arizona State Parks 2023) or in the New Mexico State Register of Historic Places (New Mexico Historic Preservation Division 2021) located beneath the existing Morenci MOA/ATCAA (Arizona State Parks 2023).

One National Historic Landmark, Point of Pines, is located beneath the existing Morenci MOA/ATCAA (NPS 2022b). Point of Pines is a set of archaeological sites located on the San Carlos

Apache Indian Reservation. This National Historic Landmark is significant due to its associations with the Ancestral Pueblo, Mogollon, and Hohokam cultures.

No National Historic Monuments, National Historic Trails, or National Historic Battlefields are located under the existing Morenci MOA/ATCAA (NPS 2022c, 2022d, 2023b).

Traditional Cultural Properties

Government-to-government consultation with Federally recognized Tribes and Pueblos to date have not identified any traditional cultural properties associated with the lands under the existing Morenci MOA/ATCAA (consultation correspondence is located in **Appendix N**).

3.10.2.5 Reserve MOA/ATCAA

Archaeological and Architectural Resources

There are no archaeological sites and seven architectural sites listed in the NRHP beneath the existing Reserve MOA/ATCAA in both Arizona and New Mexico (**Appendix M**). The architectural sites consist of one school, two USFS lookout complexes, USFS lookout cabins and shed, a mining company mill, and a post-contact historic district (NPS 2022a). Three of the NRHP-listed sites are located in Arizona and four are located in New Mexico.

There are no sites listed in the Arizona State Register of Historic Places located beneath the existing Reserve MOA/ATCAA (Arizona State Parks 2023).Four sites that are listed in the NRHP are also listed in the New Mexico State Register of Historic Places (New Mexico Historic Preservation Division 2021).

No National Historic Landmarks, National Historic Monuments, National Historic Trails, or National Historic Battlefields are located under the existing Reserve MOA/ATCAA (NPS 2022c, 2022d, 2023b).

Traditional Cultural Properties

During government-to-government consultation with Federally recognized Tribes and Pueblos, the White Mountain Apache Tribe identified Mount Baldy as a traditional cultural property located on the land under the existing Reserve MOA/ATCAA (consultation correspondence is located in **Appendix N**).

3.10.2.6 Ruby and Fuzzy MOA/ATCAA

Archaeological and Architectural Resources

There are no archaeological sites and two architectural sites listed in the NRHP beneath the existing Ruby and Fuzzy MOA/ATCAA (**Appendix M**). The architectural sites consist of one school and a historic town (NPS 2022a).

There are no sites listed in the Arizona State Register of Historic Places located beneath the existing Ruby and Fuzzy MOA/ATCAA (Arizona State Parks 2023).

No National Historic Landmarks, National Historic Monuments, National Historic Trails, or National Historic Battlefields are located under the existing Ruby and Fuzzy MOA/ATCAA (NPS 2022c, 2022d, 2023b).

Traditional Cultural Properties

Government-to-government consultation with Federally recognized Tribes and Pueblos to date have not identified any traditional cultural properties associated with the lands under the existing Ruby and Fuzzy MOA/ATCAA (consultation correspondence is located in **Appendix N**).

3.10.2.7 Sells MOA/ATCAA

Archaeological and Architectural Resources

There are five archaeological sites and six architectural sites listed in the NRHP beneath the existing Sells MOA/ATCAA (**Appendix M**). The archaeological sites consist of one multi-component site (pre-contact habitation site and post-contact cattle ranching), three historic mines, and a mountain peak (NPS 2022a) within the Organ Pipe Cactus National Monument that is sacred to the Tohono O'odham Nation and non-federally recognized Hia C-ed O'odham, which is represented by the Tohono O'odham Nation (NPS 1994b). The architectural sites consist of one school, one house, two ranches, one historic district (Ajo Townsite), and a pre-contact/post-contact 250-mile trail known as the El Camino del Diablo (NPS 2022a). While the overall length of the El Camino del Diablo is 250 miles, only a small portion is located under the Sells MOA.

There are no sites listed in the Arizona State Register of Historic Places located beneath the existing Sells MOA/ATCAA (Arizona State Parks 2023).

One National Historic Monument, Organ Pipe Cactus National Monument, is located beneath the existing Sells MOA/ATCAA (NPS 2023c). The Organ Pipe Cactus National Monument consists of many Hohokam and Patayan culture archaeological sites and is the only place in the U.S. where the senita and organ pipe cactus grow wild (NPS 2018).

Ventana Cave, a National Historic Landmark is located beneath the existing Sells MOA/ATCAA (NPS 2022b). Ventana Cave is located on the Tohono O'odham Indian Reservation.

No National Historic Trails or National Historic Battlefields are located under the existing Sells MOA/ATCAA (NPS 2022d, 2023b).

Traditional Cultural Properties

A known archaeological site, I'itoi Mo'o (Montezuma's Head) and 'Oks Daha (Old Woman Sitting), is a traditional cultural property located on lands under the existing Sells MOA/ATCAA and is used by the Tohono O'odham Nation and non-federally recognized Hia-Ced O'odham which is represented by the Tohono O'odham Nation for ceremonial purposes and to worship I'itoi (NPS 1994b). Government-to-government consultation with Federally recognized Tribes and Pueblos to date have not identified any other traditional cultural properties associated with the lands under the existing Sells MOA/ATCAA (consultation correspondence is located in **Appendix N**).

3.10.3 Environmental Consequences

Impact analysis for cultural resources focuses on assessing whether the Proposed Action or alternatives have the potential to affect cultural resources that are eligible for listing in the NRHP (known as historic properties which include traditional cultural properties) or have traditional significance for Native American groups. Under Section 106 of the NHPA, the lead agency is responsible for determining whether any historic properties are located in the area; assessing whether the proposed undertaking would adversely affect the resources and notifying the SHPO or Tribal Historic Preservation Officer of any adverse effects.

An adverse effect is any action that may directly or indirectly change the characteristics that make the historic property eligible for listing in the NRHP. If an adverse effect is identified, the Federal agency consults with the SHPO/Tribal Historic Preservation Officer, federally recognized Tribal Nations, and if applicable, the Secretary of the Interior to develop measures to avoid, minimize, or mitigate the adverse effects of the undertaking.

Analysis of potential adverse effects on historic properties, including traditional cultural properties, is based on the following considerations: (1) physically altering, damaging, or destroying all or part of a resource; (2) altering characteristics of the surrounding environment that contribute to resource significance; (3) introducing visual, audible, or atmospheric elements that are out of character with the property or alter its setting; or (4) neglecting the resource to the extent that it deteriorates or is destroyed. The potential to directly disturb historic properties can be assessed by identifying the type and location of the Proposed Action. Effects that are farther removed from the immediate project area, including visual, audible (noise), or atmospheric changes due to project implementation are harder to quantify.

Impacts to historic properties, including traditional cultural properties, are evaluated for lands beneath the MOAs, and especially the proposed low-level training MOA airspace. Because the proposed project is an airspace action, only those historic properties that would reasonably be affected by visual and noise intrusions are considered in this EIS.

Visual and noise intrusions could include low-level overflights, sonic booms, and distribution of chaff and flare residual materials. Historic properties potentially affected include very significant historic sites such as National Historic Landmarks or properties listed in, or eligible for listing in, the NRHP that qualify because of setting or feeling, historic architectural resources or archaeological resources with standing structures (such as historic ranches or forts that could be affected by vibrations), national historic trails, and traditional cultural properties that are associated with places that require isolation or quiet. Noise, including infrequent sonic booms and startle effect impacts to traditional cultural properties, may be related to interference with ceremonies and other traditional activities at sacred sites. Undisturbed habitats, resources, and settings are considered to be critical to religious practices (NPS 1994).

The DAF recognizes that hundreds of other cultural resources and historic properties, some documented and some not yet discovered, exist under the airspace. Aircraft operations have the potential to adversely affect historic structures and districts where setting is an important criterion for significance and where noise vibrations from sonic booms or low-level overflights could adversely affect those types of resources. These resources are typically found in the NRHP or State Register. Conversely, if NRHP-listed properties are not adversely affected by the project elements, then non-listed resources are unlikely to be affected. In general, archaeological sites would not incur any effects as a result of the Proposed Action. However, archaeological sites listed in the NRHP were included in the analysis, as some are standing structures and rock art sites. Potential impacts to these areas would be the same as potential impacts to architectural sites from sonic boom overpressures.

Some prehistoric archaeological sites could contain natural structures such as rock shelters or caves, and petroglyphs or pictographs, which are etched or painted onto the rock surfaces. However, studies have found that these types of natural formations are not affected by noise vibrations, such as sonic booms, any more than by natural erosion, wind, or seismic activity (Battis 1983). A more recent study from 1999 analyzed sonic boom effects at four selected petroglyph/pictograph sites on Nellis Air Force Range and adjacent overflight lands (White and Orndorff 1999). Visual observation of the physical properties at each of these sites determined that the rock panel degradation was consistent with natural weathering and chemical alteration process and not the result of sonic booms (White and Orndorff 1999).

Chaff and flares are currently used in all the MOAs except for Tombstone MOA. Chaff and flares deployed from the aircraft would not pose a visual intrusion, as flares are small in size and burn only for a few seconds and the high relative altitude of the flights would make them virtually undetectable to people on the ground. Chaff dispensed by the aircraft would be undetectable to people on the ground. Overall, chaff and flares are unlikely to adversely affect historic properties to include archaeological sites or standing structures and will not be further discussed. Impacts to traditional cultural properties are more difficult to assess and no studies have been conducted on traditional cultural resources with regard to chaff and flare residual materials.

Experimental data and models (Battis 1988; Sutherland 1990; King 1985; King et al. 1988) show that damage to architectural resources, including adobe buildings, is unlikely to be caused by subsonic noise and vibrations from aircraft overflights. Subsonic, noise-related vibration damage to structures requires high dB levels generated at close proximity to the structures and in a low frequency range (USFS 1992; cf. Battis 1983, 1988). Aircraft must generate an L_{max} of at least 120 dB to even potentially result in structural damage (Battis 1988) and, even at 130 dB, structural damage is unlikely. Sutherland (1990) found that the probability of damage to a poorly constructed or poorly maintained wood frame building is less than 0.3 percent even when the building is directly under a large, high-speed aircraft flying only a few hundred feet AGL.

Sonic booms can be associated with structural damage. Overpressure values are used to provide a general picture of psf resulting from sonic booms associated with supersonic flight. Actual overpressure varies based on maneuvers (climb/descent, turns, acceleration/deceleration) and specific weather conditions (winds, vertical temperature/pressure profile). Most damage claims are for fragile or brittle objects, such as glass and plaster. There is a large degree of variability in damage experience, and much damage depends on the pre-existing condition of a structure.

Tests by the Air Force on sonic booms have found that most structures in good condition are not affected by sonic booms with a peak overpressure of less than 16 psf. Tests by the National Aeronautics and Space Administration have shown that structures in good condition are undamaged by overpressures of up to 11 psf. Damage to plaster is in a comparable range of glass but depends on the condition of the plaster. Adobe faces risks similar to plaster, but assessment is complicated by adobe structures being exposed to weather, where they can deteriorate in the absence of any specific loads. In general, structural damage from sonic booms should be expected only for overpressures over 10 psf (Plotkin and Sutherland 1990).

Typical outdoor structures such as buildings, windmills, radio towers, etc., are resilient and routinely subject to wind loads far in excess of sonic boom pressures. 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 from these factors. Some degree of damage to glass and plaster should thus be expected whenever there are sonic booms, but usually at a low rate. **Table 3.10-1** provides general descriptions of the type of damage that could be possible by various overpressure values. As indicated in the table, structural damage is unlikely in structures in good repair. Most damage would occur in fragile structures that are in disrepair and exposed to sonic booms with a high psf.

3.10.3.1 Alternative 1 – No Action

Under the No Action Alternative, the MOAs would continue to be used for current and projected future training and no modifications would occur. Thus, the environmental impacts from this training are accounted for or represented in the current Cultural Resources characteristics described in **Section 3.10.2**. The low-level overflights would have a startle effect for individuals or wildlife on the ground, due to the low altitude and speed of training aircraft. The noise environment under the No Action Alternative within the MOAs is relatively low with all but two areas remaining below 55 dB DNL. While certain frequencies (such as 30 Hz for window breakage) may be of more concern than other frequencies, conservatively, only sounds lasting more than 1 second above a sound level of 130 dB are potentially damaging to structural components (Committee on Hearing, Bioacoustics, and Biomechanics 1977). As shown in **Section 3.4.3.1**, *Single Event Calculations,* the peak sound level for an overflight occurs for about 1/8 of a second and none of the peak sound levels would exceed this value under the current airspace. Thus, breakage is not anticipated from subsonic overflights.

Supersonic overflight under the No Action Alternative currently occurs in all the MOAs/ATCAAs except for Ruby, Fuzzy, and Tombstone (supersonic flight is authorized in Tombstone but does not currently occur). In all MOAs/ATCAAs, the CDNL is below the level expected to result in annoyance (62 dBC CDNL).

A specific, single location may or may not experience a sonic boom, although sonic booms of varying intensity could occur anywhere beneath the airspace where supersonic flight occurs. Tombstone, Outlaw, Jackal, Morenci, and Reserve MOAs/ATCAAs all have a FL300 minimum altitude for supersonic operations. For an F-16C aircraft flying straight and level at 30,000 feet, the sonic boom experienced directly beneath the flight path ranges from 1.5 to 1.6 psf depending on the aircraft speed (see **Table 3.4-7 in Section 3.4.3.2**, *Sonic Boom Calculations*). The F-35A results in slightly higher overpressure values at this altitude ranging from 1.7 to 1.8 psf depending on the speed. Within Bagdad, Gladden, and Sells MOAs, the minimum altitude for supersonic flight is 10,000 feet MSL resulting in higher psf values for single overflights: 4.2 to 4.7 for an F-16C and 4.9 to 5.3 for an F-35 depending on the aircraft speed.

The types of structures most susceptible to sonic booms are glass and adobe or similar plaster-type materials. Historic standing structures within the lands beneath the affected airspace consist primarily of wood or log buildings with window glass and some adobe or earth block structures. The infrequency and the random nature of the sonic booms suggest that structural damage to historic structures would be unlikely.

Table 3.10-1 Potential Damage from Sonic Boom Overpressure

Sonic Boom Overpressure Nominal (psf)	Structural Element	Potential Type of Damage and Item(s) Affected
0.5–2 psf	Glass	Extension of existing crack; potential for failure for glass panes in bad repair; failure potential for existing good glass panes is less than 1 out of 10,000 at 2 psf.
	Ceiling Plaster	Fine cracks; extension of existing cracks; mostly from fragile areas.
	Wall Plaster	Fine cracks; extension of existing cracks less than in ceilings; over door frames; between some plasterboards; mostly from fragile areas.
	Roof	Older roofs may have slippage of existing loose tiles/slates; sometimes new cracking of old slates at nail hole; new and modern roofs are rarely affected.
	Bric-a-brac	Those carefully balanced or on edges can fall; fine glass, such as large goblets, can fall and break.
2–4 psf	Glass	Glass pane failures may occur that are difficult to forecast in terms of the glass panes' existing localized condition. Nominally in good condition.
	Ceiling Plaster	Estimated rate of cracking ranges from less than 1 out of 5,000 (2 psf) to 1 out of 625 (4 psf).
	Wall Plaster	Estimated rate of cracking ranges from less than 1 out of 10,000 (2 psf) to 1 out of 1,000 (4 psf).
	Roof	Potential for nail peg failure if eroded.
	Bric-a-brac	Increased risk of tipping or falling objects.
4–10 psf	Glass	Regular failures within a large population of well-installed glass (1 out of 50 [10 psf] to 500 [4 psf]); failure potential industrial and greenhouse glass panes.
	Ceiling Plaster	Estimate rate of cracking ranges from 1 out of 526 (4 psf) to 1 out of 10 (10 psf). Potential for partial ceiling collapse of good plaster; complete collapse of very new, incompletely cured, or very old plaster.
	Wall Plaster	Estimated rate of cracking ranges from less than 1 out of 1,000 (4 psf) to 1 out of 50 (10 psf). Measurable movement of inside "party" walls at 10 psf.
	Roof	Regular failures within a large population of nominally good slate, slurry wash; some change of failures in tiles on modern roofs; light roofs (bungalow) or large area can move bodily.
	Bric-a-brac	Increased risk of tipping or falling objects.
>10 psf	Glass	Some good glass will fail regularly (greater than 1 out of 10) to sonic booms and at an increased rate when the wavefront is normal to the glass pane. Glass with existing faults could shatter and fly. Large window frames move.
	Ceiling Plaster	Plasterboards displaced by nail popping.
	Wall Plaster	Most plaster affected. Internal party walls can move even if carrying fittings such as hand basins or taps; secondary damage due to water leakage.
	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; rarely domestic chimneys dislodged if not in good condition.
	Bric-a-brac	Some nominally secure items can fall, e.g., large pictures, especially if fixed to "party" walls.

Legend: > = greater than; psf = pounds per square foot.
Source: Haber and Nakaki 1989.

3.10.3.2 Alternative 2 – Proposed Action

The low-level overflights would have a startle effect for individuals and wildlife on the ground, due to the low-altitude and speed of training aircraft. When compared to the No Action Alternative, Alternative 2 would not result in significant changes to the DNL and L_{dnmr} in any of the MOAs, although some MOAs would have a noticeable change: Jackal, Jackal Low, Outlaw, and Gladden/Bagdad MOAs, and parts of the Tombstone MOA (see **Section 3.4.3.2**, *Noise*, *Alternative 2*). None of the predicted DNL values exceed 65 dB DNL, indicating the noise exposure is compatible with all land uses. As shown in **Section 3.4.3.1**, *Single Event Calculations*, the peak sound levels for F-16 or F-35 overflights at 100 feet AGL could be as high as 130 dB, the level that could be potentially damaging to structural components (Committee on Hearing, Bioacoustics, and Biomechanics 1977), but this peak sound level only occurs for about 1/8 of a second reducing the potential for damage. It should be noted that overflights at less than 500 feet would be very rare (see **Table 3.4-6**).

Supersonic flight would be authorized at a minimum of 5,000 feet AGL in Tombstone, Outlaw, Jackal, Morenci, and Reserve MOAs. As shown in **Section 3.4.3.4**, *Noise*, *Alternative 2*, none of these areas would have a CDNL that exceeds 62 dBC CDNL, indicating annoyance is not a concern. Supersonic overflight at the proposed low altitude would result in sonic booms with higher intensity than the No Action Alternative. At the proposed minimum altitude (5,000 feet AGL), an F-16C would produce overpressures ranging from 7.5 to 8.3 psf depending on the speed (see **Table 3.4-7**). This would represent an increase of 6.0 to 6.7 psf over the No Action Alternative. Similarly, an F-35A at the proposed minimum altitude (5,000 feet AGL) would produce overpressures ranging from 8.4 to 9.4 psf depending on the speed. This results in increases of 6.7 to 7.6 psf over the No Action Alternative. Additionally, due to the many variables involved in the training activities within the existing and proposed MOAs, it is impossible to predict when and where sonic booms may occur. The types of structures most susceptible to sonic boom overpressures are glass and adobe or similar plaster-type materials (see **Table 3.10-1**). Historic standing structures within the land beneath the affected airspace consist primarily of wood or log buildings with window glass and some adobe or earth block structures. The maximum predicted psf for sonic booms associated with the Proposed Action would be less than 10, which does have the potential to result in glass breakage and cracks in plaster. While a single sonic boom may have a high psf and the potential for damages, the infrequency and the random nature of these booms suggest that structural damage to historic structures would be unlikely.

The change in setting created by minor increased noise from the overflights, startle effects, and very infrequent sonic booms could have an adverse effect on traditional cultural properties as well as other areas where traditional ceremonies are held. Establishing temporary or seasonal altitude restrictions would be one way to reduce adverse effects on these properties. Part of the consultation process is working to identify periods of avoidance and locations to minimize noise and visual impacts on religious ceremonies for all Tribal Nations affected by the proposed project. In addition to traditional cultural properties, cultural landscapes, archaeological sites, and natural sites (such as rivers) are all locations where religious ceremonies are held. Ongoing government-to-government consultation between the DAF and Tribal Nations could identify measures to reduce intrusive impacts (see **Appendix N** for correspondence).

The change in setting created by minor increased noise from the overflights and possible sonic booms could have an adverse effect on National Historic Landmarks. In accordance with 36 CFR § 800.10, special requirements for protecting National Historic Landmarks, the DAF must, to the maximum extent possible, minimize harm to any National Historic Landmark that may be directly and adversely affected by an undertaking (36 CFR 800.10(a)). The DAF is consulting with NPS on potential impacts to National Historic Landmarks. This consultation will develop measures to avoid, minimize, or mitigate the adverse effects of the undertaking on the National Historic Landmarks.

3.10.3.3 Alternative 3

Under Alternative 3, the predicted DNL values are similar in all MOAs to those described in Alternative 2. The potential impacts from noise and single event overflights would be the same as described in **Section 3.10.3.2,** but under Alternative 3, overflights at 100 feet AGL would be possible in the Tombstone and Jackal MOAs. The potential to experience an overflight at 100 feet would be very rare (see **Table 3.4-6**). As with Alternative 2, the minimum altitude for supersonic flight in Tombstone, Jackal, Outlaw, Morenci, and Reserve MOAs would be reduced to 5,000 feet AGL. The potential structural impacts from sonic booms would be the same as described in **Section 3.10.3.2** and glass breakage and plaster cracks would be rare, but possible. The infrequent occurrence of sonic booms and random nature suggest that structural damage would be unlikely.

3.10.3.4 Alternative 4

Under Alternative 4, the potential impacts from subsonic noise exposure and single events would be the same as described in **Section 3.10.3.2**. Under Alternative 4, the minimum altitude for supersonic flight in Tombstone, Jackal, Outlaw, Morenci, and Reserve MOAs would be reduced to 10,000 feet AGL. This would result in increased overpressures from sonic booms, but at a lesser degree than those described under Alternative 2. At the proposed minimum altitude (10,000 feet AGL), an F-16C would produce overpressures ranging from 4.2 to 4.7 psf depending on the speed (see **Table 3.4-7**). This represents an increase of 2.7 to 3.1 psf over the No Action Alternative. Similarly, the F-35A at the proposed minimum altitude (10,000 feet AGL) would produce typical overpressures ranging from 4.9 to 5.3 psf depending on the speed. This results in increases of 3.2 to 3.5 psf over the No Action Alternative. The potential damage from sonic booms would be similar to those described for Alternative 2 and glass breakage and plaster cracks would be possible. The infrequent occurrence of sonic booms and random nature suggest that structural damage would be unlikely.

3.10.4 Cumulative Impacts

Structural damage is not expected from infrequent sonic booms although there is no ability to direct sonic booms away from a specific location on the ground. Low-level overflights, sonic booms, and visual intrusions may interfere with cultural or spiritual practices or ceremonies and may be perceived as an adverse impact which could cumulatively contribute to adverse impacts from past, present, and reasonably foreseeable actions. Mineral excavation, on the ground military training, and border wall construction projects could impact cultural resources (see **Appendix G).**

Any Federal project that includes ground-disturbing activities has the potential to adversely affect cultural resources. The projects in **Appendix G** are also subject to NEPA compliance and Section 106 of the NHPA consultation prior to project start. Such projects include construction of a new Customs Border Patrol border barrier along the U.S.-Mexico border and other border security enhancements, wind farms, pipelines, oil, gas, or coal development, threat emitter sites, or any other ground-disturbing undertaking that affects public land. While the construction of the Customs Border Patrol border wall is intended to deter disturbance from border crossing activity, the construction of the border wall itself has a high-to-moderate potential to impact cultural resources and could contribute to negative cumulative effects. The Proposed Action or any of the alternatives would not be expected to contribute to significant cumulative effects.

3.10.5 Mitigations

The change in setting created by minor increased noise from the overflights, startle effects, and very infrequent sonic booms could have an adverse effect on traditional cultural properties as well as other areas where traditional ceremonies are held. Ongoing government-to-government consultation between the DAF and Tribal Nations would identify measures to avoid, minimize, or mitigate the adverse effects of the undertaking on the traditional cultural properties and areas of traditional importance (see **Appendix N** for correspondence).

The change in setting created by minor increased noise from the overflights and possible sonic booms could have an adverse effect on National Historic Landmarks. The DAF is consulting with NPS regarding the potential of adverse effects to National Historic Landmarks. This consultation will develop measures to avoid, minimize, or mitigate the adverse effects of the undertaking on the National Historic Landmarks.

3.11 HAZARDOUS MATERIALS

3.11.1 Definition of Resource and Regulatory Framework

Hazardous materials are identified and regulated under the Comprehensive Environmental Response, Compensation, and Liability Act; the Occupational Safety and Health Act; and the Emergency Planning and Community Right-to-Know Act. Hazardous materials analysis typically considers the use and disposal of hazardous materials at a particular facility and discusses the total amount of material on the installation, environmental cleanup sites, and SOPs in processing hazardous materials. For this Proposed Action, however, the analysis will consider the potential introduction of hazardous materials within existing or proposed MOAs. The introduction of hazardous materials into the environment could occur by an aircraft mishap or crash. While aircraft mishaps are rare (refer to **Section 3.3**, *Safety*, for mishaps statistics), this section focuses on the hazardous materials that could be released and the emergency response procedures that would be followed in the unlikely event of an aircraft mishap or crash.

3.11.2 Affected Environment

The affected environment for hazardous materials includes the existing and proposed MOAs. These airspace units would be used by DAF aircrews during fighter aircraft (primarily F-16, F-35, and A-10) pilot training. Operational aircraft consist of various components and fluids that may be hazardous if inadvertently released to the environment.

A Hazardous Aerospace Material Mishap Emergency Response Integrated Process Team was chartered in 2000 by the Deputy Assistant Secretary of the Air Force for Environmental, Safety, and Occupational Health. The goals of the Hazardous Aerospace Material Mishap Emergency Response project were to identify and inventory all hazardous aerospace materials on DAF weapon systems and ensure procedures were in place to protect personnel from safety/health hazards associated with aerospace vehicle mishaps. The DAF has developed specific emergency response procedures for aircraft mishaps involving hazardous materials.

Emergency procedures include how to respond to known solid, liquid, and gaseous products; radioactive materials; composite materials; radar absorbing and conventional coatings materials; and other materials and situations that can pose health and safety hazards. Hazardous materials associated with most aircraft include jet fuels, ethylene glycol, and hydraulic fluid. In addition to these common materials, the emergency power unit for the single engine F-16 fighter jet uses hydrazine, a highly volatile propellant, to restart the engine in case of emergency. Hydrazine is also used in agricultural chemicals, chemical blowing agents, pharmaceuticals, photography chemicals, boiler water treatment, and textile dyes. Acute (short-term) exposure to high levels of hydrazine may include irritation of the eyes, nose, and throat, dizziness, headache, nausea, pulmonary edema, seizures, and coma in humans (USEPA 2000). Hydrazine rapidly degrades in the environment (USEPA 2000).

Radioactive materials are used in small quantities for navigation systems, instruments, and some coatings. Composite materials are used in most aircraft in some form. Newer aircraft such as the F-22 and F-35 use extensive amounts of composite materials for the fuselage and the equipment. Older aircraft still have aluminum frames and skins but some equipment is made from composite materials to save weight. Once composite materials are put into use, they have fully hardened and are inert; however, the materials turn into hazardous materials when burned at high temperatures typical of an aircraft crash. The emergency procedures take into consideration the burning effects performed during tests on composite materials. The test program included full-scale fire testing of composite materials for toxicology and expected exposure to response personnel.

Some general conclusions included (Wright et al. 2003):

- Burn data suggest that the combustion characteristics of composite materials are roughly equivalent to other combustible materials. Combustion products released by burning composite materials are similar to those released from other solid combustibles.
- Burning of composite materials can release fibers that are respirable.
- Respirable fibers released from burning composite materials can penetrate into the lungs, causing respiratory irritation. Factors known to affect the toxicity of these inhaled fibers include dosage, physical dimensions, retention time in the lung, location of deposition in the lung, and solubility of the fibers in the lung.
- Exposed fibers along the edges of fragmented composite debris present a dermal puncture hazard. The skin can be irritated and sensitized if punctured by exposed fibers.
- The toxicity of combustion products from burning aircraft composite materials currently used does not appear to be exceptional. Types and quantities of combustion products from burning composite materials fall within the same spectrum as other burning combustibles at an aircraft mishap site.
- No additional smoke toxicity hazards created by burning composite materials were identified.
- Personal protective equipment recommendations for firefighters responding to composite aircraft mishaps include a self-contained breathing apparatus, standard firefighter protective clothing and/or proximity suits, and steel-tipped/shanked boots.

Conventional coating materials include a variety of materials that are applied to aircraft similar to paint designed to protect critical parts from extreme weather and temperature. Radar absorbing materials are also applied similar to paint to help aircraft from being detected by enemy radar.

The DAF follows a set of SOPs during aircraft mishaps to identify potential hazardous materials and situations, protect responding personnel and the environment from immediate hazards, and to provide guidelines for the ultimate cleanup and disposal of crash residues.

3.11.3 Environmental Consequences

3.11.3.1 Alternative 1 – No Action

Under the No Action Alternative, DAF aircrews would continue to conduct training operations in the existing airspace areas. There would continue to be the potential for hazardous materials to be introduced into the environment under these areas in the unlikely case of an aircraft mishap. The environmental impacts from this training are accounted for or represented in the current Hazardous Materials and Wastes characteristics described in **Section 3.11.2**.

Hazardous materials that could be introduced into the environment in the event of a mishap include jet fuels, ethylene glycol, and hydraulic fluid. In addition to these common materials, the emergency power unit for the single engine F-16 fighter jet uses hydrazine, a highly volatile propellant, to restart the engine in case of emergency. Radioactive materials are used in small quantities for navigation systems, instruments, and some coatings. Composite materials are used in most aircraft in some form.

When an aircraft crashes, it may release hydrocarbons. Those petroleum, oils, and lubricants not consumed in a fire could contaminate soil and water. The potential for contamination is dependent on several factors. The porosity of the surface soils would determine how rapidly contaminants are absorbed. The specific geologic structure in the region would determine the extent and direction of the contamination plume. The locations and characteristics of surface and groundwater in the area would also affect the extent of contamination to those resources.

F-16 aircraft carry a small quantity of hydrazine in a sealed canister that is designed to withstand crash impact damage. Hydrazine is a highly volatile propellant that contains toxic elements. It is carried on the F-16 as part of the emergency power unit. When used for this purpose, hydrazine is completely consumed, and poses no safety hazard. In any crash that is severe enough to rupture the canister, it is most likely that fire would also be involved. In this case, the hydrazine would also burn and be completely consumed. Any hazards associated with the brief time the hydrazine was burning would be very localized to the crash site and short term. Any fumes from hydrazine would be gone by the time first responders or any person could approach the crash site. In the unlikely event that the hydrazine should be released but not consumed by fire, impacts on soils and groundwater are likely to be of minor consequence. Hydrazine absorbs water at room temperature. It is incombustible in solution with water at concentrations of 40 percent or less and it evaporates at any given combination of constant meteorological conditions (i.e., temperature, humidity, wind speed, etc.) at a rate slightly slower (approximately 11 percent) than water.

Movement of hydrazine through natural soils has been shown to be slow and limited. Due to its absorption and natural decomposition processes, the probability of released hydrazine significantly contaminating groundwater is considered extremely low. However, if a Class A accident occurred and the hydrazine canister were ruptured, no fire consumed the hydrazine, and quantities of hydrazine were to reach a surface water body, aquatic life in those areas experiencing high concentrations could be significantly impacted.

The DAF has SOPs in the event of an aircraft mishap to identify potential hazardous materials and situations, protect responding personnel and the environment from immediate hazards, and to provide guidelines for the ultimate cleanup and disposal of the crash residues. See **Section 3.3.3.2**, *Ground Safety, Crash Response* for detailed description of DAF response and involvement of other first responders. Aircraft mishaps are rare; therefore, hazardous material releases from aircraft mishaps under the No Action Alternative would be minimal.

3.11.3.2 Alternative 2 – Proposed Action

Under Alternative 2, DAF aircrews would conduct training operations in all of the existing airspace areas and within the new expansion area of Tombstone MOA. There would be the potential for hazardous materials to be introduced into the environment under airspace areas in the unlikely case of an aircraft mishap. The potential impacts associated with the unlikely release of hazardous materials (to include hydrazine), radioactive materials, or composite materials would be the same as those described under Alternative 1 – No Action. The DAF has SOPs in the event of an aircraft mishap to identify potential hazardous materials and situations, protect responding personnel and the environment from immediate hazards, and to provide guidelines for the ultimate cleanup and disposal of the crash residues. Aircraft mishaps are rare; therefore, hazardous material releases from aircraft mishaps under Alternative 2 would be minimal.

3.11.3.3 Alternative 3

Under Alternative 3, DAF aircrews would conduct training operations in all of the existing airspace areas as described under Alternative 1 – No Action. The potential impacts associated with the unlikely release of hazardous materials (to include hydrazine), radioactive materials, or composite materials would be the same as those described under Alternative 1 – No Action.

3.11.3.4 Alternative 4

Under Alternative 4, DAF aircrews would conduct training operations in all of the existing airspace areas and within the new expansion area of Tombstone MOA. The potential impacts associated with the unlikely release of hazardous materials (to include hydrazine), radioactive materials, or composite materials would be the same as those described under Alternative 2 – Proposed Action.

3.11.4 Cumulative Impacts

Hazardous materials would be introduced into the environment in the case of an aircraft mishap under any of the ongoing or planned military training activities listed in **Appendix G**. Under any action, mishap impacts would continue to be mitigated by SOPs that identify potential hazardous materials, protect responding personnel and the environment, and provide guidelines for the ultimate cleanup and disposal of the crash residues. Therefore, impacts to hazardous materials would be minimal and would not be expected to contribute measurably to cumulative effects.

3.11.5 Mitigations

There are no significant impacts from hazardous materials, thus there are no mitigations required.

3.12 VISUAL EFFECTS

3.12.1 Definition of Resource and Regulatory Framework

Visual resources are physical features such as land, water, vegetation, animals, and structures that are visible in a landscape. The elements of the visual area (e.g., scenery, vegetation, surface rocks, soil, and other features) can either add or remove value from the scenic quality of the landscape. The overall visual appeal of the landscape is a reflection of the viewer's values, relations, and experiences. The landscape includes both the sky and the ground, which provides a broad composition of visual elements.

Visual impacts are described in NEPA and CEQ regulations under the heading of aesthetics. Visual resources make up the aesthetic qualities of an area. These regulations identify aesthetics as one of the factors in the human environment that must be considered in determining the effects of a proposed action. FAA Order 1050.1F, *Environmental Impacts: Policies and Procedures* (FAA 2015), and the FAA Order 1050.1F Desk Reference (FAA 2023a) require analysis to determine the extent to which a Proposed Action and alternatives would produce light emissions that would create annoyance or interfere with activities or contrast with or detract from the visual character of the existing environment. Visual impacts associated with traditional cultural properties, religious ceremonies, or otherwise identified during government-to-government consultations with Native American Tribes are addressed in **Section 3.10**, *Cultural Resources.*

The EIS analysis of visual effects does not evaluate the topic of light emissions further because the potential for light emissions would be associated only with lights on aircraft during nighttime training. Military aircraft training already occurs in the environment during nighttime. The proportion of operations that would occur at night is relatively low and would remain unchanged with the Proposed Action (see **Table 2.2-4**). While the floors of some MOAs (parts of Tombstone, Outlaw, Jackal, Bagdad, and Gladden MOAs) would be lowered with the Proposed Action allowing for military aircraft to conduct nighttime training lower than is done currently, the aircraft lights on military jets would not be any different than lights on other existing non-military users of the airspace. Given the infrequency of nighttime operations and the fact that this training already occurs in all of the MOAs, aircraft lighting at night would cause no change that would create annoyance or interfere with activities or contrast with or detract from the visual character of the existing environment.

The Federal Land Policy and Management Act and The National Forest Management Act provide management and sustainment of visual resources according to their quality. Management and sustainment of visual resources is particularly important in the area of interest where much of the land has high scenic value. The visual effects analysis is limited to the lands beneath the MOAs with a proposed lower floor than the current floors (parts of Tombstone C, Tombstone Expansion area, Jackal, Outlaw, Gladden and Bagdad MOAs). As shown in **Section 3.7.2,** various types of lands beneath the proposed airspace offer recreational opportunities that may rely on visual resources (e.g., hiking; viewing natural features, wildlife, and historic sites; camping; fishing; hunting; driving for pleasure; bicycling; horseback riding).

The floors of the MOAs would remain relatively unchanged in the following: Tombstone A and B (the current floor is 500 feet AGL, the proposed action would lower these to 100 feet AGL), Tombstone

(Exclusion Area), Morenci, Reserve, Sells, Fuzzy, and Ruby MOAs. Thus, further evaluation of visual effects is not necessary for these MOAs.

3.12.2 Affected Environment

The land beneath the proposed airspace covers various landscapes, including some areas with appreciative visual quality. In this region, a viewer finds appreciative scenery within Coronado National Forest, Apache National Forest, and various other Wilderness and Natural Areas. Views from high mountains overlooking numerous rivers, lakes, and streams along with forested environments are valued because of the untouched nature and unique geologic features. Boaters, hikers, mountain bikers, and anglers experience extraordinary views of the topography. Because of the remoteness of the underlying area, several Wilderness Areas exhibit high visual quality due to their naturalness.

Conserving visual quality is a high management priority for these protected areas. **Section 3.7**, **Table 3.7-1**, **Table 3.7-2**, and **Table 3.7-3** provide land ownership in acres under each MOA by agency, including recreational area and wilderness area beneath the existing configurations that have high aesthetic and visual quality. However, this action would not cause any physical changes to the terrestrial landscape. Therefore, this analysis does not present scenic-quality ratings of the landscapes beneath the airspace.

3.12.3 Environmental Consequences

The visual impact analysis evaluates the following factors in assessing impacts on visual resources:

- The value of the affected landscape, as determined by federal agencies, tribes, or the public.
- Any physical changes to the visual environment.
- The frequency, duration, and proximity of visual change either in the landscape or for the viewer.
- The potential for the activity to block the visibility of an area with high visual sensitivity.
- The potential for a new light source to interfere with activities or impact nighttime hours.

Potential visual impacts resulting from the Proposed Action would have short-term effects from aircraft overflight. The analysis considers the visibility, frequency, duration, and proximity of aircraft overflights within the surrounding visual environment.

The viewer's location in perspective to aircraft overflight is also considered in the analysis. Visibility depends on the distance between the aircraft and the viewer. **Figure 3.12-1** shows visibility of the aircraft at representative altitudes within the airspace in the field of vision from an observer on the ground. Visibility is also affected by intervening objects such as landforms, vegetation, or structures that block the viewer from seeing the aircraft, particularly when aircraft are traveling at lower altitudes.

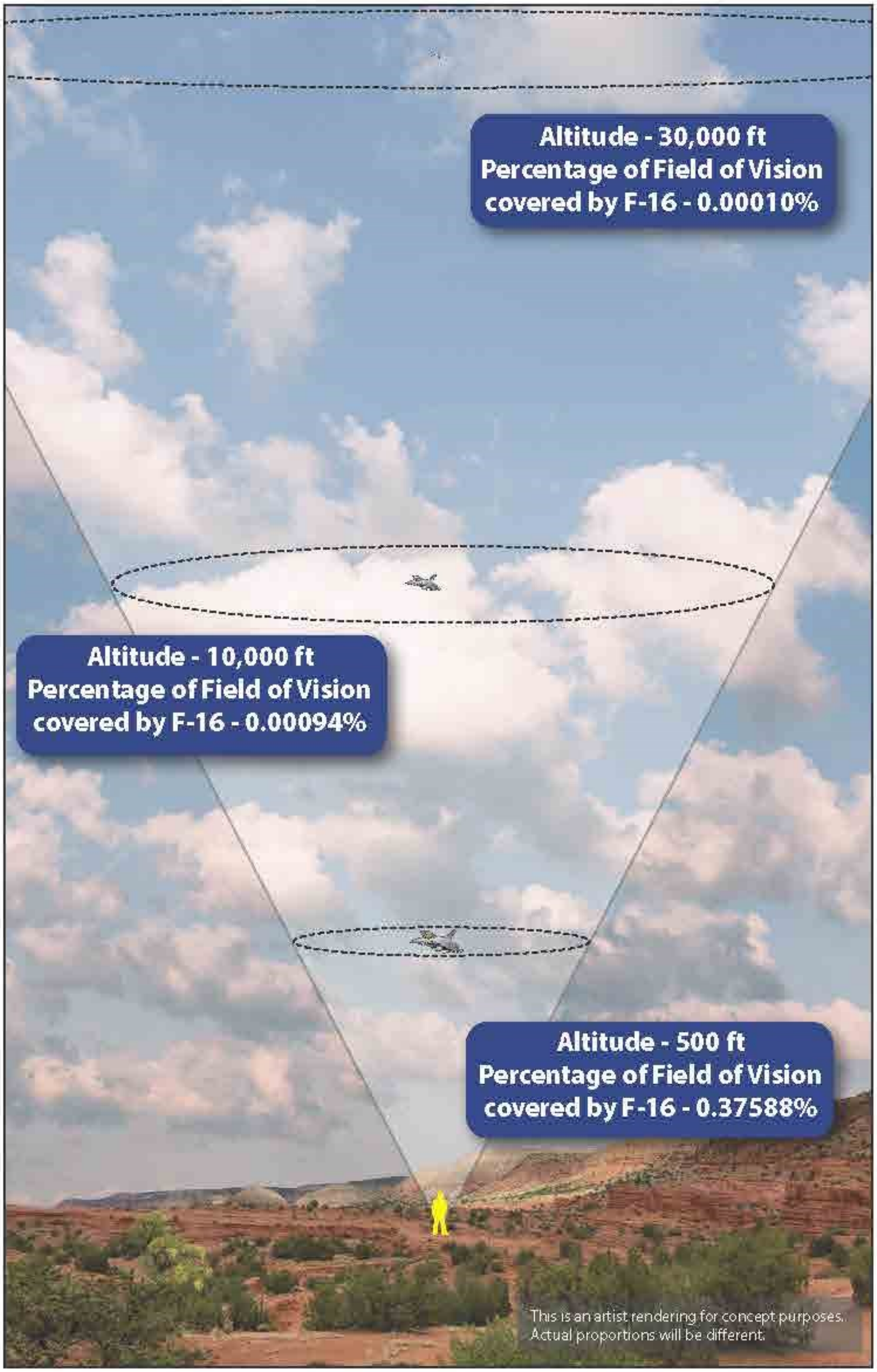


Figure 3.12-1 Visual Effects Perspective

Viewer response and interpretation of aircraft overflight varies. Depending upon cultural and instinctual perceptions of danger and sensitivity of the presence of the overflight, visual effects of overflights may have an indirect impact on qualities valued in rural and Wilderness Areas. Startle effects are possible for low flying aircraft at high speed in proximity to a person in the underlying landscape. The visibility of this type of overflight is temporary since the duration of overflights is generally brief. Both visual and noise effects from this type of overflight can cause a person near to have physiological responses from anxiety or fear. These effects would not cause a visual impact because visual change is temporary.

Some areas underlying the proposed airspace have high visual sensitivity, such as Wilderness Areas and Wilderness Study Areas, National Forests, recreation areas with minimal man-made alterations, Tribal lands, and scenic trails and overlooks. The overflight of low flying aircraft at high speed in these areas are more likely to have an impact because of the high visual-quality ratings and level of visual management protection that is more affected by change.

The Proposed Action would not result in any physical changes to the visual setting of underlying lands. Therefore, the Proposed Action has no potential to change the visual or aesthetic quality of any landscape.

3.12.3.1 Alternative 1 – No Action

Under the No Action Alternative, the MOAs would continue to be used for military training as they are currently and no modifications would occur . These operations are intermittently visible to people on the ground beneath the airspace. Because overflights occur over a large area at various altitudes, and because people are widely dispersed, visible overflights are infrequent. Overall, negligible effects to visual resources would occur from ongoing training in the existing airspace. Training activities create brief visual events in the overlying area and have negligible influence on the landscape below. Under the No Action Alternative, these conditions would not change.

3.12.3.2 Alternative 2 – Proposed Action

Under Alternative 2, training events would occur at lower altitudes in the Tombstone, Outlaw, Jackal, Bagdad, and Gladden MOAs (see **Section 2.1.2**) and would likely be more visible to observers on the ground in these areas. Similar to the No Action Alternative, these operations would be intermittent and occur over a large geographic area.

At approximately 500 feet AGL, a military jet would affect 0.38 percent of an observer's field of vision (see **Figure 3.12-1**). Thus, the duration and visibility of overflights within the proposed airspace depends on factors such as intervening objects that block the viewer's sight, the direction the individual is facing, and how clearly the individual can see. Within parts of the Tombstone MOA (A and B), overflights already occur at 500 feet AGL. Lowering the floor to 100 feet AGL would not be a significant change in terms of visibility. Expanding the northern boundary of Tombstone MOA would expose new land areas to military overflights and would likely be a noticeable change in that area. The proposed change to the floors of Outlaw, Jackal, Bagdad and Gladden would be a bigger adjustment and likely a noticeable difference to observers on the ground. These lower overflights could affect people differently based on experience and the recreational activity involved.

Moderate disruption of naturalness and unconfined recreation activities in Wilderness Areas and Wilderness Study Areas, as well as scenic values in rural areas underlying the proposed airspace is also possible due to temporary visual effects. This disruption could indirectly impact the agencies that are responsible for maintaining the characteristics of underlying protected areas and other sensitive locations.

Overall, under Alternative 2, visual effects would be minor in most areas, but could be moderate in some visually sensitive areas, with potential indirect impacts to naturalness and unconfined recreation activities in Wilderness Areas and Wilderness Study Areas, as well as scenic values. Operations at lower altitude are typically very short in duration and infrequent, reducing the overall potential for visual disturbance.

3.12.3.3 Alternative 3

Under Alternative 3, impacts would be similar to those described in Alternative 2 – Proposed Action. The impacts would be the same in all MOAs except that Jackal MOA would be lowered to 100 feet AGL as opposed to 500 feet AGL under Alternative 2. This could result in higher visibility of low-altitude aircraft when compared to Alternative 2 – Proposed Action depending on the surrounding topography of an observer. Low-level flights are more readily obscured by mountains or other terrain features.

Overall, Alternative 3 would have minor visual effects in most areas, but could be moderate in some visually sensitive areas, with potential indirect impacts to naturalness and unconfined recreation activities in Wilderness Areas and Wilderness Study Areas, as well as scenic values. Operations at lower altitude are typically very short in duration and infrequent, reducing the overall potential for visual disturbance.

3.12.3.4 Alternative 4

Under Alternative 4, impacts would be the same as those described in Alternative 2 – Proposed Action. Overall, Alternative 4 visual effects would be minor in most areas, but could be moderate in some visually sensitive areas, with potential indirect impacts to naturalness and unconfined recreation activities in Wilderness Areas and Wilderness Study Areas, as well as scenic values. Operations at lower altitude are typically very short in duration and infrequent, reducing the overall potential for visual disturbance.

3.12.4 Cumulative Impacts

Visual change would continue to be temporary within the airspace and would not result in any physical changes to the visual setting of underlying lands. None of the cumulative actions in **Appendix G** are expected to contribute to visual effects, thus the Proposed Action and alternatives would not be expected to contribute to significant cumulative effects.

3.12.5 Mitigations

There are no significant visual impacts, thus there are no mitigations required. Potential visual or aesthetic impacts to traditional cultural properties or religious ceremonies identified during consultation with Tribes will be discussed in Section 3.10.5.

4.0 REFERENCES

Air Combat Command (ACC). 2008. Cumulative Analysis Report on the Effects of Military Jet Aircraft Noise on the Occupancy and Nesting Success of the Mexican Spotted Owl (*Strix occidentalis lucida*) 2002-2005. Langley Air Force Base, Virginia.

Air Force Safety Center. 2015. About Avian Hazard Advisory System. Available online: http://www.usahas.com/about.html. Accessed on 18 August 2023.

Air Force Safety Center. 2019. Wildlife Strikes by Phase of Operation. Available online: https://www.safety.af.mil/Divisions/Aviation-Safety-Division/Aviation-Statistics. Accessed on 24 August 2023.

Air Force Safety Center. 2021. Statistics by Aircraft. Available online: https://www.safety.af.mil/Divisions/Aviation-Safety-Division/Aviation-Statistics. Accessed on August 24, 2023.

Air Force Safety Center. 2022. Mishap Investigation Process. Available online: https://www.safety.af.mil/Home/Mishap-Investigation-Process. Accessed on 24 August 2023.

Air Force Safety Center. 2020. BASH Class A, B, C, & D Mishaps by Fiscal Year. Available online: https://www.safety.af.mil/Divisions/Aviation-Safety-Division/Aviation-Statistics. Accessed on 24 August 2023.

Air National Guard (ANG). 2019. 162nd Wing Bird/Wildlife Aircraft Strike Hazard (BASH) Plan. March.

American Community Survey. 2021. 2017-2021 American Community Survey 5-Year Estimates; data downloads for Poverty, Employment Industry, and Housing.

Arizona Flight Training Working Group. 2022. Arizona Practice Areas and Reporting Points. Available online: https://aftw.org/arizona-practice-areas. Accessed on 30 August 2023.

Arizona Game and Fish Department (AZGFD). 2022a. Arizona's State Wildlife Action Plan: 2012-2022. Arizona Game and Fish Department, Phoenix, Arizona.

AZGFD. 2022b. Arizona Environmental Online Review Tool Report: Regional Special Use Airspace Optimization: Bagdad/Gladden. Project ID: HGIS-15362. Generated 21 January 2022.

AZGFD. 2022c. Arizona Environmental Online Review Tool Report: Regional Special Use Airspace Optimization: Outlaw/Jackal/Morenci/Reserve. Project ID: HGIS-17248. Generated 9 September 2022.

AZGFD. 2022d. Arizona Environmental Online Review Tool Report: Regional Special Use Airspace Optimization: Sells/Ruby/Fuzzy. Project ID: HGIS-17246. Generated 9 September 2022.

AZGFD. 2022e. Arizona Environmental Online Review Tool Report: Regional Special Use Airspace Optimization: Tombstone. Project ID: HGIS-17247. Generated 9 September 2022.

Arizona State Parks. 2023. Arizona Register of Historic Places. Available online: https://azstateparks.com/arizona-register-of-historic-places-arhp. Accessed on 04 January 2023.

Bailey, R.G. 1995. Descriptions of the Ecoregions of the United States. Second Edition. Miscellaneous Publication No. 1391. U.S. Department of Agriculture Forest Service, Washington, D.C.

Barber, J.R., K.R. Crooks, and K.M. Fristrup. 2009. The costs of chronic noise exposure for terrestrial organisms. Trends in Ecology and Evolution. Volume 25, Number 3: 180-189.

Battis, J.C. 1988. The Effect of Low Flying Aircraft on Archaeological Sites, Kayenta, Arizona. Air Force Geotechnical Laboratory. Technical Memorandum No. 146.

Battis, J.C. 1983. Seismo-Acoustic Effects of Sonic Booms on Archaeological Sites, Valentine Military Operations Area. Air Force Geophysical Laboratory. Report AFGL-TR-83-0304.

Beason, R. 2004. What can Birds Hear? Proceedings of the Vertebrate Pest Conference. Volume 21.

Bell, W. B. 1972. Animal response to sonic booms. The Journal of the Acoustical Society of America, 51(2C), 758-765.

Bowles, A.E. 1995a. Responses of Wildlife to Noise. In: Wildlife and Recreationists: Coexistence Through Management and Research (R.L. Knight and K.J. Gutzwiller eds). Island Press, Washington D.C.

Bowles, A.E., J. Francine, S. Wisely, J.S. Yaeger, and L. McClenaghan. 1995b. Effects of Low Altitude Aircraft Overflights on the Desert Kit Fox (*Vulpes macrotis arsipus*) and its Small Mammal Prey on the Barry M. Goldwater Air Force Range, Arizona, 1991-1994. U.S. Air Force Research Laboratory Report: AFRL-HE-WP-TR-2000-0101. February.

CBS News. 2023. Phoenix Sees Temperatures of 110 or Higher for 31st Stright Day. July. Available online: https://www.cbsnews.com/news/heat-dome-forecast-phoenix-temperature/. Accessed on 20 September 2023.

Committee on Hearing, Bioacoustics, and Biomechanics. 1977. Guidelines for Preparing Environmental Assessments on Noise. The National Research Council, National Academy of Sciences.

Committee on Hearing, Bioacoustics and Biomechanics. 1981. Assessment of Community Noise Response to High-Energy Impulsive Sounds. Report of Working Group 84, Committee on Hearing, Bioacoustics and Biomechanics, Assembly of Behavioral and Social Sciences. National Research Council, National Academy of Sciences. Washington, DC.

Council on Environmental Quality (CEQ). 1997. Environmental Justice, Guidance Under the National Environmental Policy Act.

CEQ. 2005. Guidance on the Consideration of Past Actions in Cumulative Effects Analysis.

CEQ. 2023. National Environmental Policy Act Guidance on Consideration of Greenhouse Gas Emissions and Climate Change. January.

Delaney, D. K., Grubb, T. G., Beier, P., Pater, L. L., & Reiser, M. H. 1999. Effects of Helicopter Noise on Mexican Spotted Owls. *The Journal of Wildlife Management*, *63*(1), 60–76. https://doi.org/10.2307/3802487.

Delaney, D.K. 2002. Prioritization of Threatened and Endangered Species Sound Research on Army Installations. November.

Department of the Air Force (DAF). 1994. A Position Paper for The Effects of Aircraft Noise on Domestic Animals.

DAF. 1997. Environmental Effects of Self-Protection Chaff and Flares. August.

DAF. 2006. Technical Order 00-105E-9 and STANAG 3896, Aerospace Emergency Rescue and Mishap Response Information.

DAF. 2011. Supplemental Report. Environmental Effects of Training with Defensive Countermeasures. October.

DAF. 2012. F-35A Training Basing Final EIS. June. Available online: https://apps.dtic.mil/sti/citations/ADA612501. Accessed on 13 September 2023.

DAF. 2013. 56th Fighter Wing Bird/Wildlife Aircraft Strike Hazard (BASH) Reduction Plan. April.

DAF. 2021. Final Environmental Assessment Playas Special Use Airspace Davis-Monthan Air Force Base, Arizona.

DAF. 2022a. Climate Action Plan. October. Available online: https://www.safie.hq.af.mil/Programs/Climate/. Accessed on 20 October 2022.

DAF. 2022b. Air Emissions Guide for Air Force Mobile Sources. Available online: https://aqhelp.com/Documents/2022%20Mobile%20Guide%20-%20FINAL.pdf. Accessed on 20 September 2023.

DAF. 2023a. Programmatic Environmental Assessment for Implementation of Bird/Wildlife Aircraft Strike Hazard Management Procedures.

DAF. 2023b. Programmatic Environmental Assessment for Testing and Training with Defensive Countermeasures.

Department of Defense (DoD). 2023. DoD Directive 5030.19. DoD Responsibilities on Federal Aviation. 6 March.

Department of Defense Noise Working Group (DNWG). 2009. Community Annoyance Caused by Noise from Military Aircraft Operations. Technical Bulletin. December.

DNWG. 2013a. Noise-Induced Hearing Impairment – Technical Bulletin. December.

DNWG. 2013b. Non-Auditory Health Effects of Aircraft Noise. Technical Bulletin. December.

DNWG. 2013c. Speech Interference from Aircraft Noise. Technical Bulletin. December.

Department of the Navy. 2018. Naval Air Station Whidbey Island Complex Growler Final Environmental Impact Statement, Volume 2. Appendix A1. September.

Dooling, R. and A. Popper. 2007. The Effects of Highway Noise on Birds. September.

Dufour, P.A. 1980. Effects of Noise on Wildlife and Other Animals: Review of Research Since 1971.U.S. Environmental Protection Agency. Office of Noise Abatement and Control. July.

Ellis, D.H., 1981. Responses of raptorial birds to low level military jets and sonic booms. Institute for Raptor Studies, Oracle, Arizona.

Ellis, D.H., C.H. Ellis, and D.P. Mindell. 1991. Raptor Responses to Low-Level Jet Aircraft and Sonic Booms. *Environmental Pollution*, Volume 74, pp. 53-83.

Erickson, Helen, Karl Hoerig, and John Welch. 2024. Fort Apache and Theodore Roosevelt School National Historic Landmark. Available online: https://sah-archipedia.org/buildings/AZ-01-017-0034.

European Network on Noise and Health. 2013. Final Report European Network on Noise and Health. European Union Project No. 226442, FP-7-ENV-2008-1.

Evans, J.C, S.R.X Dall, and C.R. Kight. 2018. Effects of ambient noise on zebra finch vigilance and foraging efficiency. *PLoS ONE* 13(12):e0209471. Available online: https://www.ncbi.nlm.nih.gov/pmc/articles/PMC6312262/pdf/pone.0209471.pdf. Accessed on 25 February 2020.

Federal Aviation Administration (FAA). 2014. Circular Advisory Wake Turbulence. February.

FAA. 2015. FAA Order 1050.1F, Environmental Impact: Policies and Procedures. July 16.

FAA. 2023a. FAA Order 1050.1F Desk Reference. Version 3 (June 2023). Federal Aviation Administration Office of Environment and Energy.

FAA. 2023b. FAA Order JO 7400.2P. Procedures for Handling Airspace Matters.

Federal Interagency Committee on Urban Noise (FICUN). 1980. Guidelines for Considering Noise in Land Use Planning and Control.

Fidel, S., B. Tabachnick, and L. Silvati. 1996. Effects of Military Aircraft Noise on Residential Property Values. Final Report. BBN Report No. 8102. October 16.

Finegold, L.S., C. Stanley Harris, and H.E. von Gierke. 1994. Community Annoyance and Sleep Disturbance: Updated Criteria for Assessing the Impacts of General Transportation Noise on People. *Noise Control Eng. J.* 42 (1), 1994 Jan–Feb.

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

Gladwin, D.N., K.M. Manci, and R. Villella. 1988. Effects of Aircraft Noise and Sonic Booms on Domestic Animals and Wildlife. Bibliographic Abstracts, NERC-88/32. Ft. Collins, CO: U.S. Fish and Wildlife Service National Ecology Research Center.

Gierens, K., S. Matthes, and S. Rohs. 2020. How Well Can Persistent Contrails Be Predicted? *Aerospace*, 7(12), 169, doi:10.3390/aerospace7120169.

Gierens, K.M., U. Schumann, H.G.J. Smit, M. Helten, and G. Zängl. 1997. Determination of humidity and temperature fluctuations based on MOZAIC data and parametrization of persistent contrail coverage for general circulation models. *Ann. Geophys.,* 15(8), 1057–1066, doi:10.1007/s00585-997-1057-3.

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

Habib, L., E. Bayne, and S. Boutin. 2007. Chronic industrial noise affects pairing success and age structure of ovenbirds Seiurus aurocapilla. *Journal of Applied Ecology*, Volume 22, pp. 176-184.

Heffner, R.S. and H.E. Heffner. 1983. Hearing in Large Mammals: Horses (*Equus caballus*) and Cattle (*Bos taurus*). Behavioral Neuroscience 97: 299-309.

Hershey, R.L. and T.H. Higgins. 1976. Statistical Model of Sonic Boom Damage. ADA 028512. July.

Hole, C., R. Murray, D. Marlin, and P. Freeman. 2023. Equine Behavioural and Physiological Responses to Auditory Stimuli in the Presence and Absence of Noise-Damping Ear Covers. *Animals 2023, 13*(9)*,* 1574. https://doi.org/10.3390/ani13091574. Accessed 4 January 2023.

Iowa State University. 2023. Mesa Falcon Airfield Wind Roses. Available online: https://www.mesonet.agron.iastate.edu/sites/windrose.phtml?station=FFZ&network=AZ_ASOS. Accessed on 11 August 2023.

Interagency Working Group (IWG). 2021. Technical Support Document: Social Cost of Carbon, Methane, and Nitrous Oxide. February.

Kärcher, B. 2018. Formation and radiative forcing of contrail cirrus. *Nat. Commun.* 2018 91, 9(1), 1–17, doi:10.1038/s41467-018-04068-0.

King, W.K. 1985. Seismic and Vibration Hazard Investigations of Chaco National Historic Park. U.S. Department of the Interior, Geological Survey. Washington D.C. Open-File Report 85-529.

King, W.K., D.L. Carver, and D.M. Worley. 1988. Vibration Investigation of the Museum Building at White Sands National Monument, New Mexico. U.S. Department of the Interior, Geological Survey. Open-File Report 88-544.

Korschgen, C.E. and R.B. Dahlgren. 1992. 13.2.15. Human Disturbances of Waterfowl: Causes, Effects, and Management. Waterfowl Management Handbook. 12.

Kraussman, P.R. and L.K. Harris. 2002. Military Jet Activity and Sonoran Pronghorn. Z. Jagdwiss. 48, Supplement, 140-147

Kraussman, P.R., L.K. Harris, C.L Blasch, K.K.G. Koenen, and J. Francine. 2004. Effects of Military Operations on Behavior and Hearing of Endangered Sonoran Pronghorn. *Wildlife Monographs*, 157, pp. 1-41.

Landmark Hunter. 2021. Phelps Dodge General Office Building. Available online: https://landmarkhunter.com/182030-phelps-dodge-general-office-building/. Last updated 2021. Accessed on 11 January 2023.

Le Roux, D.S. and J.R. Waas. 2012. Do long-tailed bats alter their evening activity in response to aircraft noise? *Acta Chiropterologica*, 14(1): 111–120, 2012.

LeBlanc, M., C. Lombard, R. Massey, E. Klapstein, and S. Lieb. 1991. Behavioral and Physiological Responses of Horses to Simulated Aircraft Noise. January.

Lee, D.S., et al. 2021. The contribution of global aviation to anthropogenic climate forcing for 2000 to 2018. Atmospheric Chemistry, Volume 244. 1 January. Available online: https://www.sciencedirect.com/science/article/pii/S1352231020305689?via%3Dihub. Accessed 01 November 2023.

Lynch, T.E. and D.W. Speake. 1978. Eastern Wild Turkey Behavioral Responses Induced By Sonic Boom. In J. L. Fletcher, & R. G. Busnel (Eds.), Effects of Noise on Wildlife (pp. 47–61). New York, NY: Academic Press.

Manci, K.M., D.N. Gladwin, R. Villella, and M.G Cavendish. 1988. Effects of Aircraft Noise and Sonic Booms on Domestic Animals and Wildlife: A Literature Synthesis. U.S. Fish and Wildlife Service National Ecology Research Center, Ft. Collins, CO, NERC-88/29. 88 pp.

Morley, E.L., G. Jones, and A.N. Radford. 2014. The importance of invertebrates when considering the impacts of anthropogenic noise. *Proceedings of the Royal Society B: Biological Sciences, 281*(1776), 20132683.

National Park Service (NPS). 1994a. Report of Effects of Aircraft Overflights on the National Park System. Report to Congress.

NPS. 1994b. I'itoi Mo'o (Montezuma's Head) and 'Oks Daha (Old Woman Sitting) National Register of Historic Places Registration Form. 31 March.

NPS. 1998. Guidelines for Evaluating and Documenting Traditional Cultural Properties. National Register Bulletin.

NPS. 2015. Geospatial Sound Modeling. GIS data. Available online: https://irma.nps.gov/DataStore/Reference/Profile/2217356. Accessed on 10 August 2023.

NPS. 2021a. San Bernardino Ranch. Available online: https://www.nps.gov/places/san-bernardino-ranch.htm. Last updated 11 August 2021. Accessed on 11 January 2023.

NPS. 2021b. Sierra Bonita Ranch. Available online: https://home.nps.gov/places/sierra-bonita-ranch.htm. Last updated 12 August 2021. Accessed on 11 January 2023.

NPS. 2022a. National Register of Historic Places. Available online: https://www.nps.gov/subjects/nationalregister/database-research.htm. Last updated 28 June 2022. Accessed on 04 January 2023.

NPS. 2022b. National Historic Landmarks. Available online: https://www.nps.gov/subjects/nationalhistoriclandmarks/list-of-nhls-by-state.htm. Last updated 28 June 2022. Accessed on 11 January 2023.

NPS. 2022c. National Historic Monuments. Available online: https://www.nps.gov/subjects/archeology/national-monument-facts-and-figures.htm. Last updated 15 March 2022. Accessed on 11 January 2023.

NPS. 2022d. National Historic Battlefields. Available online: https://www.nps.gov/subjects/battlefields/visit.htm. Last updated 17 August 2022. Accessed on 11 January 2023.

NPS. 2023a. Kinishba Ruins. Available online: https://www.nps.gov/nr/travel/amsw/sw12.htm. Accessed on 11 January 2023.

NPS. 2023b. National Historic Trails. Available online: https://www.nps.gov/subjects/nationaltrailsystem/national-historic-trails.htm. Last updated 29 June 2023. Accessed on 01 November 2023.

NPS. 2023c. Organ Pipe Cactus National Monument, Arizona. Available online: https://www.nps.gov/orpi/learn/historyculture/index.htm. Last updated 14 February 2023. Accessed on 01 November 2023.

Navy. 2021. Report to Congress: Real-Time Aircraft Sound Monitoring Final Reports. Available online: https://media.defense.gov/2021/Dec/16/2002911022/-1/-1/1/Real-Time%20Aircraft%20Sound%20Monitoring%20Final%20Report%20Report%20to%20Congress.PDF/REAL-TIME%20AIRCRAFT%20SOUND%20MONITORING%20FINAL%20REPORT%20REPORT%20TO%20CONGRESS.PDF. Accessed on 6 February 2024. November.

Native Land. 2023. The Salt Song Trail Project. Available online: https://www.nativeland.org/salt-song-trail. Accessed on 01 February 2023.

Nelson, J.P. 2003. Meta-Analysis of Airport Noise and Hedonic Property Values: Problems and Prospects.

New Mexico Historic Preservation Division. 2021. National Register and State Register of Historic Places. Available online: https://www.nmhistoricpreservation.org/programs/registers.html. Last updated 29 January 2021. Accessed on 04 January 2023.

Nez, N. 2014. National Register of Historic Places Registration Form for *Chí'chil Biłdagoteel* (Oak Flat) Traditional Cultural Property. Prepared by Tonto National Forest. 22 September.

Office of Management and Budget. 2021. TSD 2021 Annual Unrounded.

Plotkin, K. 1990. Sonic Boom Focal Zones Due to Tactical Aircraft Maneuvers. AIAA Paper No. 90-4003. Proceedings of the American Institute of Aeronautics and Astronautics 13th Aeroacoustics Conference, (pp. 1–11).

Plotkin, K.J. and L.C. Sutherland. 1990. Sonic Boom: Prediction and Effects. AIAA Professional Studies Series, Tallahassee, FL, October 25-26.

Radle, L. 2007. The effects of noise on wildlife: a literature review. March 2. Available online: https://winapps.umt.edu/winapps/media2/wilderness/toolboxes/documents/sound/radle_effect_noise_wildlife.pdf. Accessed on 25 October 2023.

Reycaft. 2022. New Mexico State Historic Preservation Office Response to The Arizona Special Use Airspace Optimization. January.

Roca, I. T., L. Desrochersa, M. Giacomazzoa, A. Bertoloa, P. Bolduca, R. Deschesnesa, C.A. Martina, V. Rainvillea, G. Rheaulta, and R. Proulxa. 2016. Shifting Song Frequencies in Response to Anthropogenic Noise: A Meta-Analysis on Birds and Anurans. Behavioral Ecology.

Shannon, G., M.F. McKenna, L.M. Angeloni, K.R. Crooks, K.M. Fristrup, E. Brown, K.A. Warner, M.D. Nelson, C. White, J. Briggs, S. McFarland, and G. Wittemyer. 2016. A synthesis of two decades of research documenting the effects of noise on wildlife. *Biological Reviews* 91:982-1005.

Short, Karen C. 2022. Spatial wildfire occurrence data for the United States, 1992-2020 [FPA_FOD_20221014]. 6th Edition. Fort Collins, CO: Forest Service Research Data Archive. Available online: https://doi.org/10.2737/RDS-2013-0009.6. Accessed on 11 August 2023.

Smith, C.C. 1978. Structure and function of the vocalizations of tree squirrels (Tamiasciurus). *Journal of Mammalogy*, 59(4), pp.793-808.

Smith, D.G., D.H. Ellis, and T.H. Johnston. 1988. Raptors and Aircraft. In R.L Glinski, B. Gron-Pendelton, M.B. Moss, M.N. LeFranc, Jr., B.A. Millsap, and S.W. Hoffman, eds., Proceedings of the Southwest Raptor Management Symposium. National Wildlife Federation, Washington, D.C., pp. 360-367.

Stantec. 2023. MRNMAP, BOOMAP, and NMPLOT output files. August.

Sun, J.W. and P.M. Narins. 2005. Anthropogenic sounds differentially affect amphibian call rate. *Biological conservation*, 121(3), 419-427.

Sutherland, L.C. 1990. Assessment of Potential Structural Damage From Low Altitude Subsonic Aircraft. Wyle Labs. WR 89-16.

Texas Parks and Wildlife. 2023. Mexican long-nosed bat (*Leptonycteris nivalis*). Available online: https://tpwd.texas.gov/huntwild/wild/species/mexlongnose/. Accessed on 31 October 2023.

Teer, J.G., Truett, J.C., and Bureau of Sport Fisheries and Wildlife Seattle WA Western Fish Disease Lab. 1973. Studies of the effects of sonic boom on birds. FAA No. FAA-RD-73-148, Published by the Department of Transportation, FAA, NTIS No. AD-768-853/4.

The British Horse Society. No date. The Impact of Noise on Horses. Version 270318.

U.S. Army Center for Health Promotion and Preventive Medicine. 2005. Operational Noise Manual. November.

U.S. Census Bureau (USCB). 2010. Decennial 2010 Census. Data download tables for Population and Race.

USCB. 2020. Decennial 2020 Census. Data download tables for Population and Race; Housing Units.

U.S. Department of Agriculture. 2022a. Census of Agriculture 2022 State Agriculture Overview Arizona. Available online: https://www.nass.usda.gov/Quick_Stats/Ag_Overview/stateOverview.php?state=ARIZONA. Accessed on 2 November 2023.

U.S. Department of Agriculture. 2022b. Census of Agriculture 2022 State Agriculture Overview New Mexico. Available online: https://www.nass.usda.gov/Quick_Stats/Ag_Overview/stateOverview.php?state=NEW%20MEXICO. Accessed on 02 November 2023.

U.S. Environmental Protection Agency (USEPA). 1982. Guidelines for Noise Impacts Analysis. EPA Report No. 550/9-82-105. April 1982

USEPA. 2000. Hydrazine Summary, 302-01-2. Created April 1992, updated January 2000. Available online: https://www.epa.gov/sites/production/files/2016-09/documents/hydrazine.pdf. Accessed on 14 September 2023.

USEPA. 2009. Aircraft Engine Speciated Organic Gases: Speciation of Unburned Organic Gases in Aircraft Exhaust. May. Available online: https://nepis.epa.gov/Exe/ZyPDF.cgi/P1003YX3.PDF?Dockey=P1003YX3.PDF. Accessed on 14 September 2023.

USEPA. 2013. Level III ecoregions of the continental United States. Available online: https://gaftp.epa.gov/EPADataCommons/ORD/Ecoregions/us/Eco_Level_III_US.pdf. Accessed on 11 January 2023.

USEPA. 2023a. NAAQS Table. March. Available online: https://www.epa.gov/criteria-air-pollutants/naaqs-table. Accessed 14 August 2023.

USEPA. 2023b. Arizona Nonattainment/Maintenance Status for Each County by Year for All Criteria Pollutants. Available online: https://www3.epa.gov/airquality/greenbook/anayo_az.html. Accessed on 01 November 2023.

U.S. Fish and Wildlife Service (USFWS). 2002. Southwestern Willow Flycatcher Recovery Plan. Albuquerque, New Mexico. 210 pp., Appendices A-O.

USFWS. 2006. Endangered and Threatened Wildlife and Plants; Establishment of a Non-essential Experimental Population of Northern Aplomado Falcons in New Mexico and Arizona. Federal Register 71 (143) 42298-42315. July 26.

USFWS. 2012a. Recovery Outline for the Jaguar (*Panthera onca*). April.

USFWS. 2012b. Final Recovery Plan for the Mexican Spotted Owl (*Strix occidentalis lucida*), First Revision. U.S. Fish and Wildlife Service. Albuquerque, New Mexico, USA. 413 pp.

USFWS. 2013. Endangered and threatened wildlife and plants; designation of critical habitat for the southwestern willow flycatcher (*Empidonax traillii extimus*). January. Available online: https://www.fws.gov/species-publication-action/endangered-and-threatened-wildlife-and-plants-designation-critical-69. Accessed on 20 September 2023.

USFWS. 2016. Recovery Plan for the Ocelot (*Leopardus pardalis*), First Revision. U.S. Fish and Wildlife Service, Southwest Region, Albuquerque, New Mexico.

USFWS 2019. Western Yellow-billed Cuckoo (*Coccyzus americanus*). Basic Species Information. Available online: https://ecos.fws.gov/ecp/species/3911. Accessed on 11 January 2019.

USFWS. 2020. California Least Tern (*Sternula antillarum browni*) 5-YEAR REVIEW: Summary and Evaluation. Available online: https://ecos.fws.gov/docs/tess/species_nonpublish/3520.pdf. Accessed on 25 October 2023.

USFWS. 2023a. Information for Planning and Consulting: Bagdad MOA. Accessed on 01 September 2023.

USFWS. 2023b. Information for Planning and Consulting: Fuzzy MOA. Accessed on 01 September 2023.

USFWS. 2023c. Information for Planning and Consulting: Gladden MOA. Accessed on 01 September 2023.

USFWS. 2023d. Information for Planning and Consulting: Jackal MOA. Accessed on 01 September 2023.

USFWS. 2023e. Information for Planning and Consulting: Jackal Low MOA. Accessed on 01 September

USFWS. 2023f. Information for Planning and Consulting: Morenci MOA. Accessed on 01 September 2023.

USFWS. 2023f. Information for Planning and Consulting: Outlaw MOA. Accessed on 01 September 2023.

USFWS. 2023g. Information for Planning and Consulting: Reserve MOA. Accessed on 01 September 2023.

USFWS. 2023h. Information for Planning and Consulting: Ruby MOA. Accessed on 01 September 2023.

USFWS. 2023i. Information for Planning and Consulting: Sells MOA. Accessed on 01 September 2023.

USFWS. 2023j. Information for Planning and Consulting: Sells Low MOA. Accessed on 01 September 2023.

USFWS. 2023k. Information for Planning and Consulting: Tombstone MOA. Accessed on 13 December 2023.

USFWS. 2023l. Masked bobwhite (quail) (*Colinus virginianus ridgwayi*). Environmental Conservation Online System. Available online: https://ecos.fws.gov/ecp/species/3484. Accessed on 20 September 2023.

USFWS. 2023m. ECOS Species Profile: New Mexico meadow jumping mouse. Available: https://ecos.fws.gov/ecp/species/7965;

USFWS. 2024a. Jaguar (*Panthera onca*). Environmental Conservation Online System. Available online: https://ecos.fws.gov/ecp/species/3944#crithab. Accessed on 6 February 2024.

USFWS. 2024b. Yellow-billed Cuckoo (*Coccyzus americanus*). Environmental Conservation Online System. Available online: https://ecos.fws.gov/ecp/species/3911. Accessed on 6 February 2024.

U.S. Forest Service (USFS). 1992. Report to Congress: Potential Impacts of Aircraft Overflights of National Forest Service System Wildernesses. Prepared pursuant to Section 5, Public Law 100-91, National Park Overflights Act of 1987. July.

U.S. Geological Survey. 2022. Gap Analysis Project (GAP) 2022. Protected Areas Database of the United States (PAD-US) 3.0 (ver. 2.0, March 2023) U.S. Geological Survey data release. Available online: https://doi.org/10.5066/P9Q9LQ4B. Accessed on 13 September 2023.

White, William and Richard Orndorff. 1999. A Cultural Resource and Geological Study Pertaining to Four Selected Petroglyph/Pictograph Sites on Nellis Air Force Range and Adjacent Overflight Lands, Lincoln and Nye Counties, Nevada. Prepared by Harry Reid Center for Environmental Studies for Nellis Air Force Base, Nevada. August.

Workman, G.W., T.D. Bunch, J.W. Call, R.C. Evans, L.S. Neilson, and E.M. Rawlings. 1992. Sonic Boom/Animal Disturbance Studies on Pronghorn Antelope, Rocky Mountain Elk, and Bighorn Sheep. Utah State University Foundation: Logan. Prepared for USAF, Hill AFB, UT.

Wright, M., A. Luers, R. Darwin, J. Scheffey, H. Bowman, R. Davidson, and E. Gogley. 2003. Composite Materials in Aircraft Mishaps Involving Fire: A Literature Review. June.

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