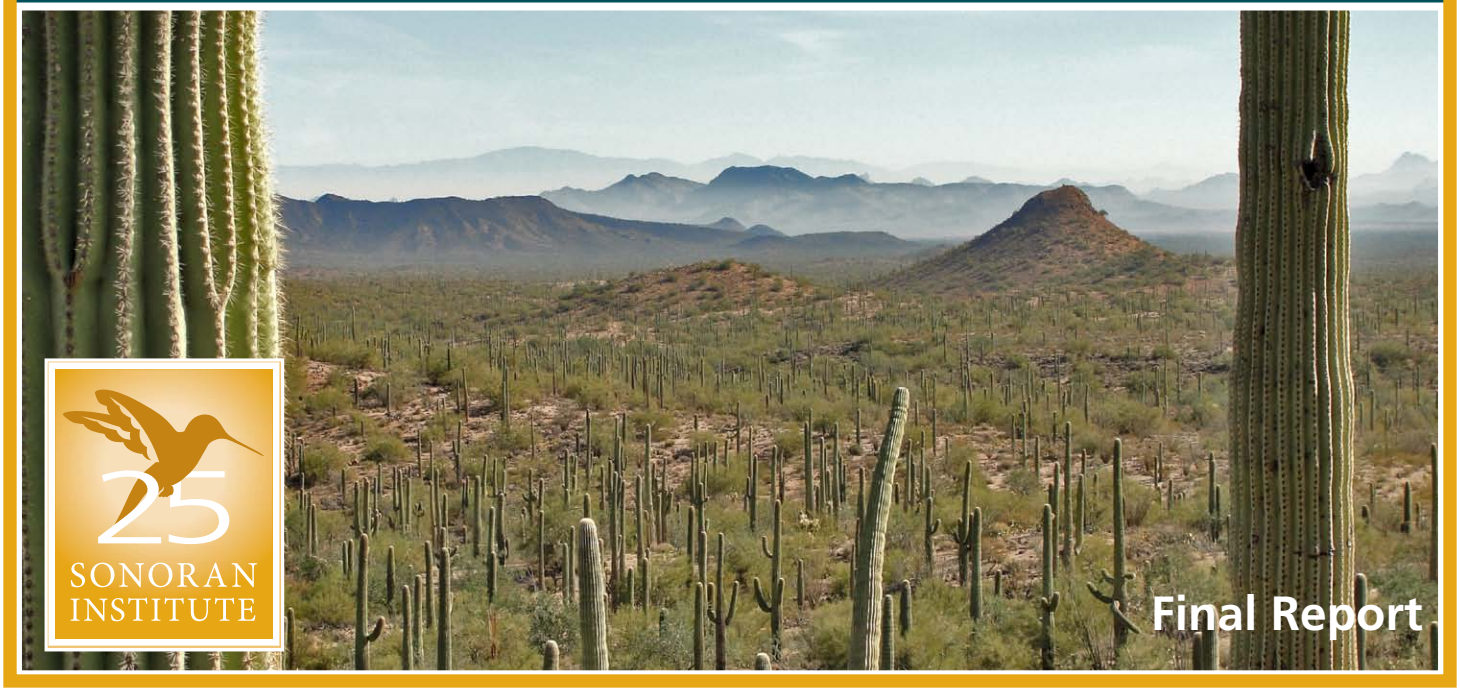
Mutual Benefit: Preserving Arizona's Military Mission and the Value of Publicly-Owned Lands



SONORAN INSTITUTE

Final Report

About the Sonoran Institute

Mission

The Sonoran Institute inspires and enables community decisions and public policies that respect the land and people of western North America.

Vision

The Sonoran Institute contributes to a vision of a West with:

- Healthy landscapes—including native plants and wildlife, diverse habitats, open spaces, clean air and water—from northern Mexico to western Canada.
- Vibrant communities where people embrace conservation to protect quality of life today and in the future.
- Resilient economies that support prosperous communities, diverse opportunities for residents, productive working landscapes, and stewardship of the natural world.

A Collaborative, Community-Based Approach

The nonprofit Sonoran Institute, founded in 1990, works across the rapidly changing West to conserve and restore natural and cultural assets and to promote better management of growth and change. The Institute's community-based approach emphasizes collaboration, civil dialogue, sound information, local knowledge, practical solutions, and big-picture thinking.

Celebrating a landmark anniversary this year; Sonoran Institute 25 years strong, shaping our West.

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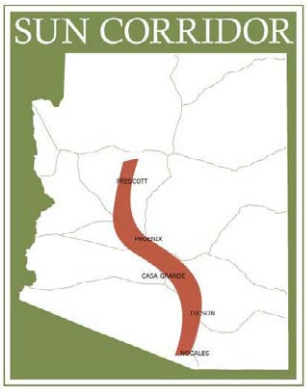
About the Sun Corridor Program



The Sun Corridor Legacy Program is one of the four keystone initiatives of the Sonoran Institute. The "Sun Corridor" refers to Arizona's megapolitan region stretching from Nogales in the south to Prescott in the north, with Phoenix and Tucson at its core. The megapolitan is growing at a tremendous rate, and that rapid growth comes with the challenge of conserving natural desert and open space while improving urban quality of life. The Sun Corridor Legacy Program's three focus areas are:

- Envisioning a healthy and prosperous Sun Corridor region;
- Engaging diversity in environmental issues and decision-making; and
- Enhancing the community by promoting strategic conservation initiatives.

The Sun Corridor's desirable climate, housing options, and relatively low cost of living are reasons why this region continues to attract new residents. Future quality of life, environmental health, and economic prosperity will largely be determined by how growth is managed. Going forward, regional solutions that comprehensively address conservation, development, transportation, water, and energy issues will be critical to a more sustainable future.

Arizonans must consider these regional issues when making decisions about how to develop communities, preserve cherished open spaces, ensure an adequate high-quality water supply, protect our quality of life, and enhance economic prosperity. New approaches to problem solving are needed to make this happen, and the Sonoran Institute finds them through work with federal, state, and local governments, and stakeholder groups to determine the best mix of land use and conservation for the region. To find out more about the program visit www.sonoraninstitute.org.

Connect with the Sun Corridor Program
on Twitter: @sonoranarizona

This view of the landscape surrounding the Las Cienegas National Conservation Area demonstrates the incredible natural beauty that the Sun Corridor region enjoys. The Las Cienegas NCA is one of Sonoran Institute's cherished achievements over its 25 year legacy.

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Image Courtesy Luke AFB

Acknowledgements

Special thanks to members of the advisory committee for their review of the technical content and accuracy of this report. Advisory committee members included representatives from Arizona's military installations, conservation groups, and business leaders. The Sonoran Institute intends this report to be an independent and objective look at issues of encroachment on the military mission as it relates to Arizona's public lands. The outcomes and content are neither sponsored, nor approved by the Department of Defense or any Arizona military facility.

Contents

What is Encroachment?

Arizona's military installations have been in operation for decades. In-fact, the majority of these bases date back to before World War II. Since the time of these early training operations much has changed around these facilities and in the science of military readiness. These changes have resulted in conflict, on occasion, between the ambitions of local communities to grow around these existing military facilities, and the need for these operations to continue and adapt to the evolving requirements of national defense preparedness. Up until the 1990's in Arizona, little effort was given to reduce the threats of encroachment, though some bases like Davis-Monthan Air Force Base in Tucson had seen significant urban development around them. After the Base Realignment and Closure (BRAC) process of 1991 in which the Williams Air Force Base in Mesa was closed, Arizona got serious about reducing the risk of encroachment from urban development immediately surrounding installations. More recently, these proactive measures have extended to non-urban encroachments in an effort to maintain the effectiveness of facilities in the face of reductions to budgets and changes in the military mission.

In this report, encroachment generally refers to actions outside of the control of the United States military that may cause risk to a military facility through reduced mission effectiveness, increased scrutiny, complaints from the surrounding community, increases in cost, or some other impairment. It is recognized that some military operations are a nuisance to communities in Arizona, though for the most part, the operations have been in place long before the community located to that area. It is the firm belief of the Sonoran Institute that with appropriate foresight and proactive attention, the military training operations in Arizona can, and should, endure.

Executive Summary

Over the past two decades, the United States Military has paid greater attention to the management and stewardship of Arizona's natural resources. Two primary reasons for these actions are: (1) military bases must preserve the realism of battlefield conditions on-the-ground; and (2) military bases must protect the integrity of their military mission from pressures posed by encroachment.

This study affirms that the United States Department of Defense sites in Arizona have been proactive in facilitating natural resource management and mitigating encroachment risks both on and off military bases. Consequently, the military in Arizona have proven to be exemplary stewards of the natural landscape. We find that Arizona's military installations are increasingly affected by encroachment situations resulting from decisions made outside of the control of the DOD.

> ***"[The Department of Defense's natural resources] core mission is to enable our military service men and women, soldiers, sailors, airmen, and marines to train as they would fight."***
>
> L. Peter Boice, DOD Deputy Director of Natural Resources (Sabella 2011, 4)

This report introduces a model of encroachment classification to analyze and resolve pressures on installations. By clearly defining encroachment into three categories: direct, indirect, and perceived, it is possible to implement the appropriate method for removing or mitigating the pressure. Three Arizona case studies help clarify this classification system: (1) the Davis-Monthan Air Force Base demonstrates resolution of direct land use encroachments; (2) Barry M. Goldwater Range illustrates resolution of indirect wildlife management encroachments; and (3) Fort Huachuca shows resolution of perceived encroachments on water resources.

By working in partnership with local governments and non-governmental entities, military installations have successfully reduced the current number of encroachment risks. Improved collaborative efforts continue with Federal agencies, including the U.S. Bureau of Land Management, U.S. Fish and Wildlife Service, the U.S. Forest Service, and the Department of Homeland Security. Although Arizona's military leaders share concerns about encroachment risks, more information is needed to understand specific concerns and potential mitigation measures for priority installations in our state; then steps can be taken to remove those pressures in an expedient manner.

The report concludes by outlining an effective set of tools for managing various forms of military encroachments. The Sonoran Institute proposes a collaborative effort that engages Arizona's military stakeholders in assessing future encroachment pressures, the degree of risk, and mitigation measures to ensure the functionality and viability of Arizona's military installations.

Arizona and the Military Mission

In 2008, The Maguire Company, in collaboration with ESI Corporation, updated their 2002 study entitled, "Economic Impact of Arizona's Principal Military Operations." Though a more contemporary update is forthcoming, the report identifies the military industry as "One of the largest and frequently overlooked industries in Arizona" (The Maguire Company 2008, 1). The study was commissioned by the State of Arizona and posits: although Arizona was largely unaffected by the Base Realignment and Closure Commission (BRAC), future BRAC activities could threaten one or more military facilities in Arizona. Additionally, "federal actions may result in the reduction or closing of military facilities within Arizona, local action and activities also endanger the future of some military operations" (The Maguire Company 2008, 2). Military facilities in this state that were once remote are now near cities, recreation areas, and in the path of future development.

> ***"Encroachment cannot be stopped by erecting fences. Buffers need to be created and managed as zones of transition and cooperation. Separation will only be temporary and will ultimately fail."***
>
> John Elwood, Col., U.S. Air Force National Guard Bureau, Andrews AFB (Elwood 2008, 88)

The conclusion of the Maguire Company report states that the military "provides substantial, stable employment, draws on the same private, non-governmental vendors and suppliers as many private commercial enterprises in the state, and serves as an important building block in the State's overall economy." (The Maguire Company 2008, 42) It also laments that historically, the $9 billion dollars in economic impact of the military's operations in Arizona have been overlooked and that state and local government shouldn't neglect the significance of these operations to local and statewide economies. In short, this $9 billion economy requires continued vigilance to sustain it.

In Arizona, the military mission encompasses the U.S. Navy, U.S. Marine Corps, U.S. Air Force, U.S. Army, and the Arizona National Guard. All of these entities have a historic and strong connection to the state and have relied upon Arizona's wide-open landscape to conduct training procedures unimpeded. Today, military operations occur in a much more complex environment and must compete with other uses of the landscape, increased population, and continual pressures on the military mission envelope which is defined as the physical area in which military training activity occurs. Table 1 identifies the many military installations and active sites that are currently in operation in Arizona. Figure 1 identifies them on a map.

Table 1: Military Facilities in Arizona

Military Facility	Location	Branch of Military
161st Air Refueling Wing	Phoenix, Maricopa County	National Guard
162nd Wing	Tucson, Pima County	National Guard
214th Reconnaissance Group	Tucson, Pima County and Sierra Vista, Cochise County	National Guard
Arizona Air National Guard Joint Forces Headquarters	Phoenix, Maricopa County	National Guard
Barry M. Goldwater Range East	Pima, Yuma and Maricopa Counties	Air Force
Barry M. Goldwater Range West	Yuma County	Marine Corps
Buckeye National Guard Target Range	Buckeye, Maricopa County	National Guard
Camp Navajo	Bellemont, Coconino County	National Guard
Davis-Monthan Air Force Base	Tucson, Pima Counties	Air Force, National Guard
Florence Military Reservation	Florence, Pinal Counties	National Guard
Fort Huachuca	Sierra Vista, Cochise County	Army
Luke Air Force Base	Glendale, Maricopa County	Air Force
Marine Corps Air Station Yuma	Yuma, Yuma County	Marine Corps
Papago Park Military Reservation	Phoenix, Maricopa County	National Guard
Picacho Peak Stagefield	Pinal County	National Guard
Silverbell Heliport	Pinal County	National Guard
U.S. Naval Observatory	Flagstaff, Coconino County	Navy
Yuma Proving Ground	Yuma and La Paz Counties	Army

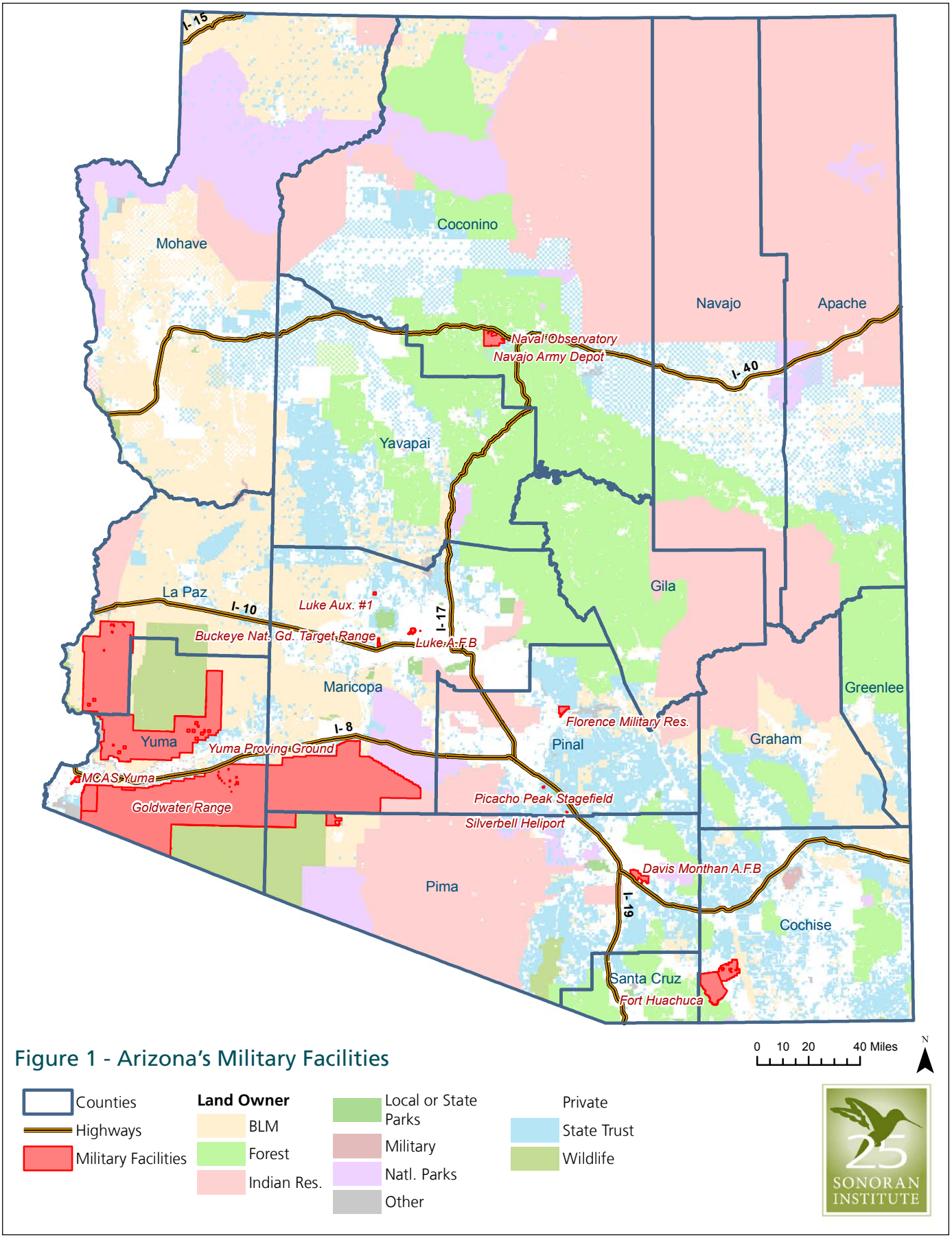


Figure 1 - Arizona's Military Facilities

Natural Resource Management and the Military Mission

In the past two decades, the U.S. Department of Defense (DOD) has spent close to $200 million to protect sensitive wildlife on its bases while maintaining or enhancing battlefield realism (Department of Defense 2014d). Such measures are necessary to ensure that federal endangered species regulations do not unduly compromise the military mission.

Beyond concerns for wildlife on the bases themselves, incompatible land uses surrounding military facilities can also detract from mission integrity. For this reason, the DOD takes a broad view on natural resource management to include diverse partnerships that extend off-base (Elwood 2008). The goal is to share the burden of conserving and restoring open spaces and wildlife habitat in order to minimize current and future impacts to the base and its mission.

Title 10 of the U.S. Code, Section 3062 (a) defines the military mission as:

- Preserving the peace and security, and providing for the defense of the United States, the Territories, Commonwealths, and possessions, and any areas occupied by the United States;
- Supporting national policies;
- Implementing the national objectives; and
- Overcoming any nations responsible for aggressive acts that imperil the peace and security of the United States (Powledge 2008).

The DOD oversees 420 military installations on 25 million acres of land (Department of Defense 2014d). Over the past two decades, the U.S. military has paid ever-increasing attention to the management and stewardship of its natural resources both on and off of these military bases. The reasons for this trend are twofold: (1) military bases must preserve the realism of battlefield conditions on-the-ground to maximize training effectiveness (B. A. Stein 2008) and; (2) military bases must protect the integrity of their military mission from pressures posed by encroachment.

Training in environments that approximate battlefield conditions tend to produce soldiers who are confident in similar landscapes during wartime. Therefore, desert ecosystems at practice ranges in the United States must be substantially intact to provide our soldiers with actual practice that can be translated when negotiating similar ecosystems abroad. For example, many Marines heading to battle in the Middle East train in the Sonoran Desert at Arizona's Barry M. Goldwater Range (BMGR) (Barry M. Goldwater Range 2012). Consequently, military bases are required to protect the integrity of their military mission from pressures posed by diverse forms of encroachment (Hagel 2014).

Federal and State Lands

Federal lands bring tremendous value to the military mission across Arizona. The state is made up of significant amounts of land owned by the federal government and managed though a variety of agencies including the U.S. Bureau of Land Management (BLM), U.S. Forest Service (USFS), National Park Service (NPS), and U.S. Fish and Wildlife Service (USFWS) (Figure 2). However, tribal lands, which comprise the largest component of Arizona's land at about 27 percent of the state, are not considered federal land for purposes of this study. Military facilities themselves only cover about four percent of Arizona including training lands like the BMGR and the Yuma Proving Ground (YPG), which are withdrawn for military use yet are owned by the Department of Interior. For this report, military lands total 2,706,884 acres and include the facilities listed in table 1. In spite of the limited amounts of land owned by the DOD, training missions crisscross the state as airplanes and helicopters move from bases to Special Use Airspace and military training facilities like the BMGR. These movements and other training maneuvers that occur outside of installations, rely on a landscape that is free of obstructions, interference, or human activities that are incompatible with their use.

The reliance of military operations on lands outside of DOD properties is well known and much effort has gone into preserving military corridors and protecting nearby private and state lands from encroachments throughout the United States. The same scrutiny and proactive measures have not occurred, however, with respect to lands owned by the federal government in the public lands system. As shown in

Figure 2: Arizona Land Tenure[1]

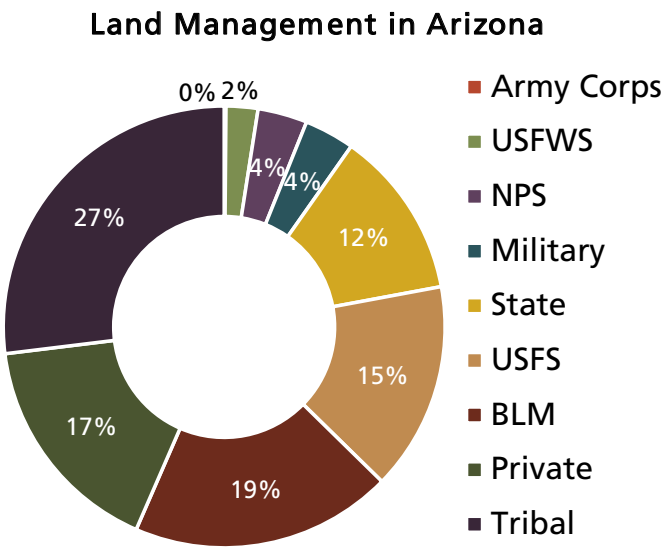


Table 2 - Military Special Use Airspace in Arizona

Military Special Use Airspace (SUA) in Arizona Occur on or over 37,783,042 acres (51.8% of the State)		
Location of Operations	**Acres**	**Percentage of SUA**
State Lands	5,360,756	14%
Federal Lands (Not including Indian Reservations)	14,016,314	37%
Publicly-Owned Lands	**19,377,070**	**51%**

table 2, over 50 percent of all land underlying Military Special Use Airspace (including Military Training Routes and Special Use Areas) in Arizona is publicly-owned by the state or federal governments. Thirty-seven percent of this land is federal land and is presumed to be open and unimpeded for military use, an assumption that ignores the broader interrelationships between publicly-owned lands and the military mission. This section will take a closer look at the need for undeveloped and ecologically healthy public lands under military operations and around Arizona's military installations. (Refer to Appendix IV and figure 3 on page 9 for details on Military Special Use Airspace in Arizona.)

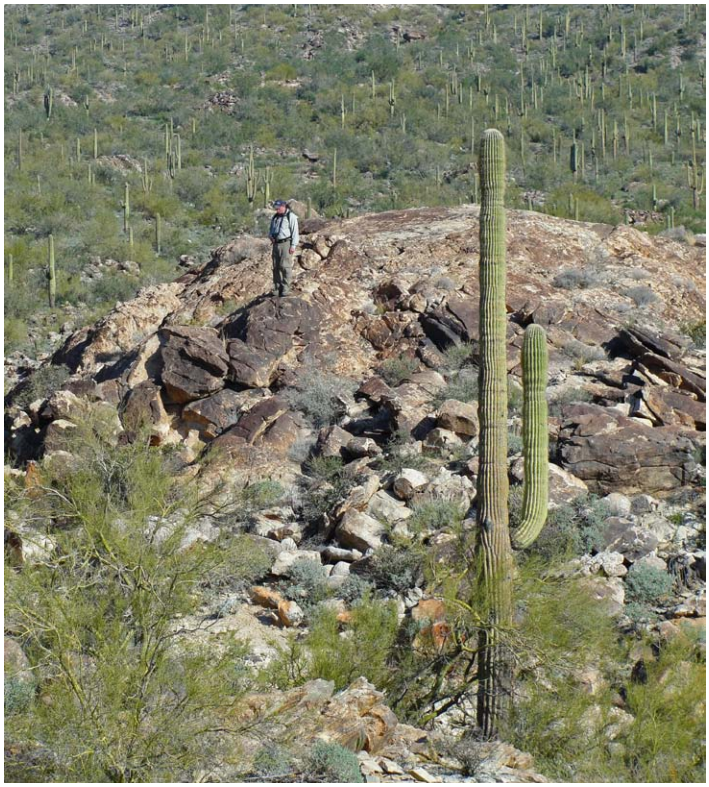
Arizona State Lands

Lands managed by the Arizona State Land Department (ASLD) make up 12 percent of the state and are virtually indistinguishable from federal lands that are nearby. Their purpose, however, is distinctly different from that of federal lands: they are held in trust for a variety of beneficiaries who receive funds from the sale and use of these lands. Within two miles of a military facility, 154,528 acres of ASLD lands occur, which can lead to increased urban pressures caused by sale and development. Currently, there is no legal mechanism for conservation of state lands other than by purchasing them from ASLD at market value or by using the authority approved by the voters of Arizona in 2012 to transfer appropriate lands between the federal and state governments. This authority, granted by Proposition 119, has yet to be used and the process is still under development, but any specific exchanges under this new process still require voter approval.

Often, state lands lie adjacent to military installations or in areas of military operations. Since conservation of these lands is impractical at any significant scale, there is concern that they could be a pathway for direct encroachment into military operations. Local communities cannot designate these lands for open space preservation and are thus powerless to prevent development in these areas. Though rarely used, the ASLD also retains "super zoning authority", allowing them to override local restrictions if they conflict with their ability to achieve "highest and best use" in the disposition of ASLD lands. As a result, state lands in military use areas or near military installations are, by their very presence, a perceived encroachment for military operations. (Refer to Appendix II for detailed maps depicting the relationship between Arizona State Trust Lands and military facilities in Arizona.)

Despite the challenges associated with compatibility planning on state trust lands, The Gila Bend Air Force Auxiliary Field/ Barry M. Goldwater Range Joint Land Use Study was completed in 2005. As required by Title 28, Chapter 25, Article 7, of the Arizona Revised Statutes (ARS) the study established areas of military compatibility around the perimeter of the installation where significant ASLD lands are present (See Appendix II). Though it varies somewhat, generally within ½ mile of the BMGR, density is capped at one unit per five acres, and within one mile of the installation the density is limited to one unit per two acres. (Yuma County 2012) While these regulations should provide some protection from urban encroachment, they cannot prohibit outright the development of residential uses which could translate into direct, indirect, and perceived encroachments.

Arizona's state trust lands occur in several areas that are of high natural resource value. In some cases, parcels of state land are completely surrounded by federally protected lands like Wilderness, national parks, and other designations. In these cases, development activities would have tremendous



Public lands such as these provide opportunities for recreation, environmental services, and unencumbered airspace for military training operations.

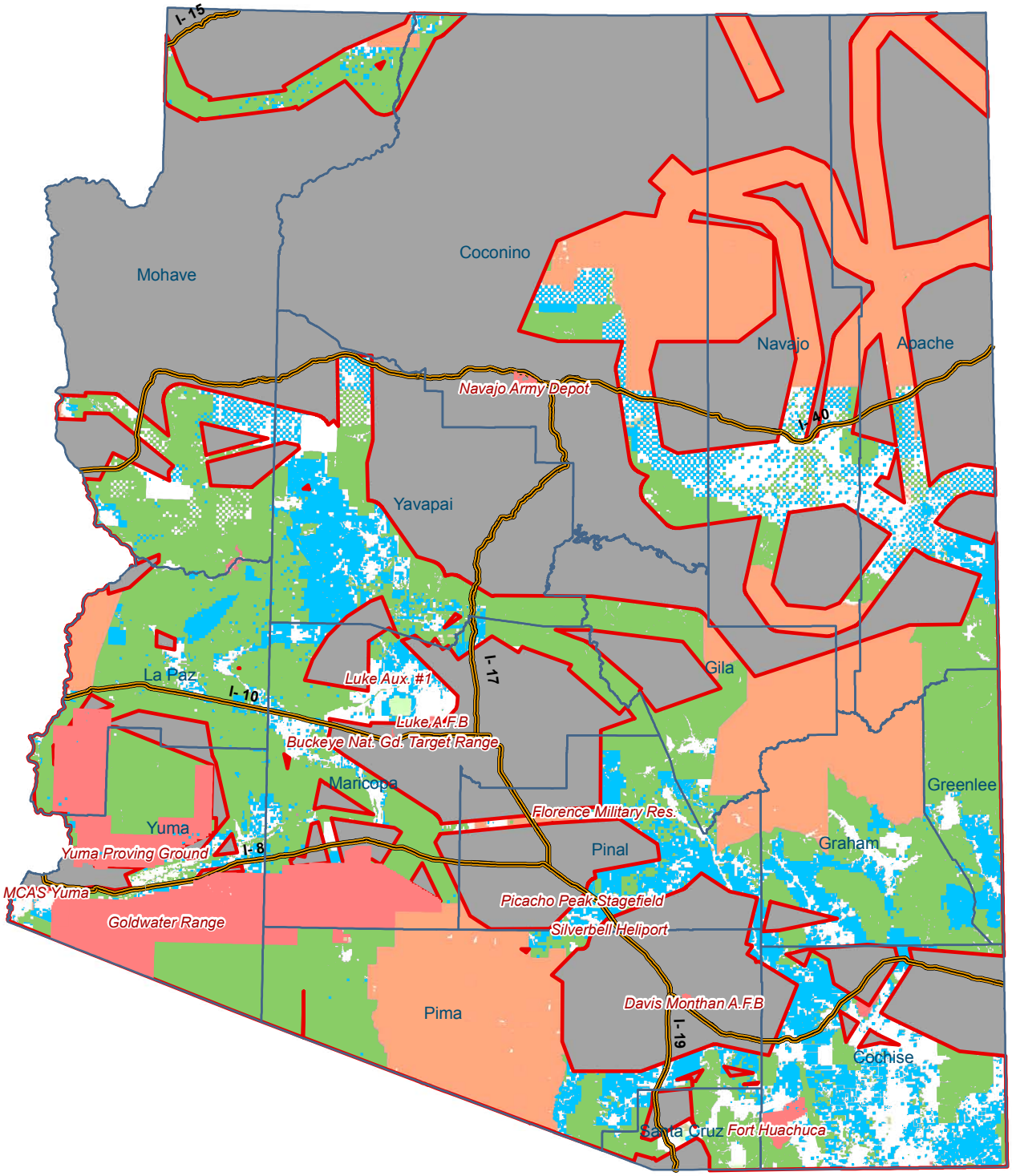


Figure 3 - Military Special Use Airspace (SUA) in Arizona

0 12.5 25 50 Miles

N

Counties
Military Facilities
Highways
Military SUA or MTR

Military Use over Federal Land
Military Use over State Land

CATEGORY
Indian Res.
Local or State Parks
Military

Other
Private
No SUA

impact on areas of high ecological value. In contrast, there are many parcels of federal land that are well situated for private development. Proposition 119 could be used to help consolidate these properties into areas where they would bring more value to the beneficiaries of Arizona's state trust land while protecting appropriate landscapes from development.

Transfer of Federal Land

Half of Arizona's land is owned and managed by the federal government including the BLM, USFWS, USFS, and NPS. This land, however, is not guaranteed to remain open for military use. Since 1962, over 2.4 million acres of federal land have been transferred to private ownership throughout the state (see figure 4). This shift has occurred for a variety of reasons including land exchanges to resolve conservation priorities and to facilitate the development of urban land and resource extraction operations. In many cases, the exchanges resulted in beneficial conservation outcomes for important environmental resources.

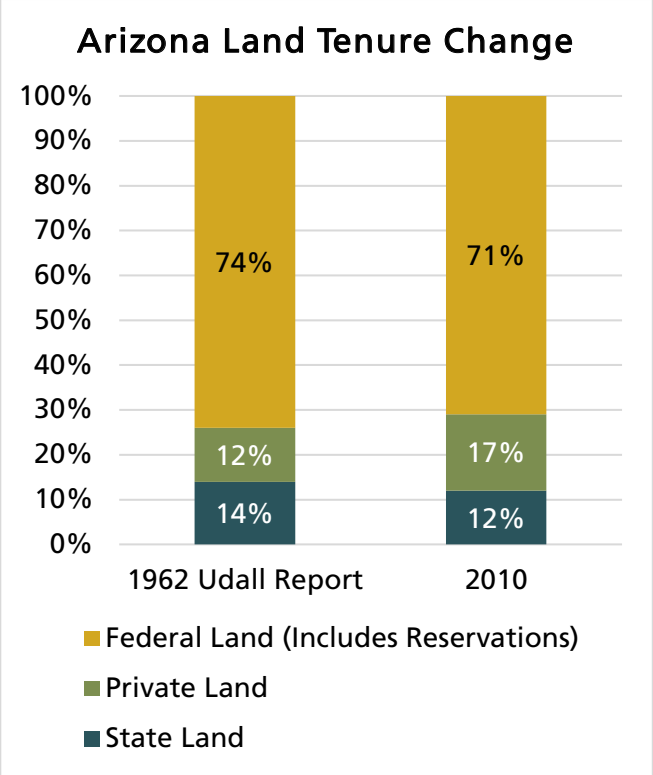
For example, In the mid-1980's a number of exchanges occurred between private landowners and the federal government in order to preserve lands with high ecological value while allowing the development of former federal lands. One such exchange led to the creation of the San Pedro Riparian National Conservation Area. The White Tanks Associates purchased approximately 43,000 acres of land along the San Pedro River and exchanged it for 40,900 acres of land owned by the BLM. This action allowed pristine natural Sonoran desert lands west of the White Tank Mountains to be released for development.[2]

In a similar exchange in 1987, 62,000 acres of BLM land in two large consolidations near Tonopah, Arizona and near Lake Pleasant were exchanged for 45,000 acres of grassland near Sonoita, Arizona. This action resulted in the federal lands that are now within the Las Cienegas National Conservation Area, which was protected through legislation in 2000. Both of these exchanges demonstrate the trade-offs that are endemic in these actions; often the conservation benefits that are achieved through the exchange result in opportunities for development or natural resource extraction on other properties.[3]

More recently, in 2014 the Southeast Arizona Land Exchange, more commonly known as the Resolution Copper exchange, was approved by Congress. This transfer involves roughly 2,400 acres of federal land in exchange for approximately 5,300 acres of private land. In this example, the federal estate will actually increase by about 2,900 acres while allowing the development of a large copper mine near Superior, Arizona.

All exchanges of federal land should be carefully analyzed in order to prevent unintended consequences to resources and other uses like those of the military. Later in this document, tools will be evaluated for their benefit to reduce the risk of exchanges on properties that are of high value for military operations.

Figure 4 - Loss of Public Land in Arizona



"Arizona was directly impacted by the 1991 BRAC evaluations that resulted in the closure of Williams Air Force Base in 1993. Recognizing that incompatible land-use and encroachment in the vicinity of Arizona's military facilities constrains their ability to perform current and future missions, a primary focus of the state's efforts to assure a sustainable future for its military installations has been to address these compatibility issues."

(Arizona State Senate 2013, 1)

Disposal of Federal Land

Disposal of federal land is a common occurrence, especially with properties that are managed by the BLM. Resource Management Plans (RMPs), the policy documents that govern each office of the BLM, identify the parcels that are available for sale. These properties are generally isolated from other federal land making it difficult for the agency to manage them in a cohesive way. Moreover, the properties for sale are often in locations that make them suitable for development. Information on disposal parcels can be found in each RMP. It is estimated that several hundred thousand acres are currently available for disposal across Arizona.[4]

Over the past several years there has been a movement in some communities to transition more land from the federal estate to allow for greater economic development. Some vocal rural communities and stakeholders have placed significant pressure on the federal government to demonstrate the economic benefit of federal lands in their jurisdiction. The use of these areas for economic benefit like military uses could help to demonstrate the value that open landscapes bring to these rural communities thereby reducing the likelihood that incompatible uses and other pressures will be placed on these lands.

Encroachment Sources on Publicly-Owned Land

Several possible sources of encroachment exist on federal and state lands in Arizona that can contribute to the impairment of military facilities and/or missions. These sources of encroachment have been less scrutinized largely due to their distance from the physical boundaries of installations and training sites. Recently, the efforts of the Western Regional Partnership and the Arizona Commander's Summit have been focusing more attention on these issues. However, more work needs to be done to consider the impacts of various activities on the viability of Arizona's military missions.

In the following sections, three Arizona case studies are evaluated to show how land use, airspace, training regimes, military budgets, loss of habitat, and impacts to the electromagnetic spectrum can cause encroachment pressures. These impacts directly affect the DOD's determination of the overall "military value" of a given base, which in turn informs DOD's Base Realignment and Closure processes to help analyze to what degree a military facility will be retained and/or utilized. The 2005 BRAC Commission defined military value as:

1. The current and future mission capabilities and the impact on operational readiness of the total force of the Department of Defense, including the impact on joint warfighting, training, and readiness.
2. The availability and condition of land, facilities, and associated airspace (including training areas suitable for maneuver by ground, naval, or air forces throughout a diversity of climate and terrain areas and staging areas for the use of the Armed Forces in homeland defense missions) at both existing and potential receiving locations.
3. The ability to accommodate contingency, mobilization, surge, and future total force requirements at both existing and potential receiving locations to support operations and training.
4. The cost of operations and the manpower implications (Defense Base Closure and Realignment Commission 2005, v).

The military value score for a given base is computed via a formal Military Value Analysis (MVA), which includes both quantitative and qualitative factors and varies slightly

Figure 5 - Direct Encroachment of Light Pollution on the U.S. Naval Observatory in Flagstaff

Artist's rendering depicting the direct encroachment of light pollution on the U.S. Naval Observatory in Flagstaff. Light pollution is one example of direct encroachment that can occur from sources far from the military facility.

depending on the military service branch. The Army's MVA, for example, includes the following factors: maneuver land, range sustainability, training facilities, airspace, and indirect fire (Hagel 2014). Range sustainability refers to "the ability of an installation to sustain training ranges based on several established encroachment factors" (Hagel 2014, 2)

The central issue that this report is addressing is in preserving the actual effectiveness of military installations in achieving their necessary training outcomes. While it is important to facilities and the surrounding communities that military operations are not curtailed or removed through a BRAC process, it is essential for the effectiveness of the military that these operations can continue uninhibited by pressures or hindrances. For this reason, the BRAC process should not be the driver of encroachment resilience efforts as it is often politically driven and unpredictable. Military installations and concerned stakeholders should maintain vigilance of possible impacts and be proactive to protect the integrity of military training activities.

Arizona's bases are taking direct proactive measures to enhance their maneuver acreage, airspace, and range sustainability in response to encroachment concerns. These measures can be summarized as:

1. Permanent protection of publicly-owned lands to prevent direct encroachment (Davis-Monthan AFB responding to adjacent urban development via State Trust land purchases);
2. Cross-jurisdictional management to mitigate indirect encroachment on training airspace including Military Training Routes (MTRs), as well as indirect encroachment from threatened and endangered wildlife species (Barry M. Goldwater Air Force Range); and
3. Permanent protection of private lands to prevent both indirect and perceived encroachment (Fort Huachuca's partnerships to acquire land that protects the electromagnetic spectrum and water resources).

The following sections unveil a new system to identify and resolve direct, indirect, and perceived encroachment and cite specific examples from Arizona's military community that further clarify the impacts of incompatible uses while highlighting the urgency of preventative actions.

Types of Encroachment

The DOD defines encroachment as "the cumulative result of any and all outside influences that inhibit normal military training, testing and operations" (Ripley 2008, 1). The concept is so important to the military that in fiscal year 2013 alone, DOD spent over $80 million on encroachment mitigation programs (Hagel 2014). A military facility is defined as an area owned or managed by any entity of the Department of Defense for the use or purpose of military training or readiness. For the purposes of this analysis, Sonoran Institute suggests three over-arching categories of encroachment to military facilities (See figure 6).

1. ***Direct Encroachment:*** A condition whereby an action, proposed action or an action's direct impacts will impair a military facility or its mission by interfering with operations. (Figure 5 provides an example of direct encroachment that occurs remotely from the military installation.)

2. ***Indirect Encroachment:*** A condition whereby an action, proposed action, or the likely results from an action or proposed action will cause impairment or impose a greater burden on a military facility through increased oversight, regulation and/or cost.

3. ***Perceived Encroachment:*** A condition whereby it possible that an action or proposed action may trigger an increased level of scrutiny or the perception of impairment to a military facility even if there is no evidence of direct or indirect encroachment.

This structure is important as it allows decision-makers to better determine the appropriate actions or proactive measures that would best address the concern. Direct and indirect forms of encroachment have been recognized by the military community in the past, although little attention has been given to the threats of perceived encroachment.

In its various forms, encroachments can limit military activities or operations that may be performed on a military base. Many factors related to land-use and natural resource management around military installations can detract from the military mission. Some examples include direct impacts from urban development adjacent to or surrounding military bases; and indirect impacts due to airspace restrictions, land-use restrictions, scheduling changes, and financial constraints (Elwood 2008). In extreme cases, cumulative impacts can compromise the integrity of the military mission on that base.

The decision matrix on page 13 (figure 6) provides a framework for identifying whether or not an action could create a possible encroachment pressure on a military facility or mission. By using this model, it is possible to categorize possible impacts into three concise groupings that can be paired with certain tools and mitigation measures. Also, this structure can allow a more comprehensive look at all impairments and minimize debate regarding which impacts are relevant for proactive measures.

Direct Encroachment

As discussed, the most visible and preventable form of encroachment or impairment to a military mission results from development or other impacts that occur in the vicinity of a military installation or the mission envelope. For this report, direct encroachment is a condition where an action, proposed action, or an action's direct impacts will impair a military installation or its mission by interfering with operations. For direct encroachment to occur, an action or its direct impacts must, in itself, cause impairment to the mission envelope. If the encroachment concern does not cause direct impairment, it likely would be considered indirect encroachment or perceived encroachment.

Arizona's Military Installation Fund and the Arizona Military Affairs Commission have been proactive to assist communities with resolving direct encroachment pressures. One such example is an effort to reduce the impact of urban development on the Hubbard Assault Strip near Huachuca City by funding the installation of sheilding on nearby street lights that were interfering with night vision activities.

Direct encroachment can take many forms, but most often it results from urban development in areas incompatible for that land use. The most obvious impact from this level of encroachment is an increased frequency of complaints that are catalogued regarding noise, dust, and other impacts from military-related operations. Other types of direct encroachment are identified in table 3. For a list of encroachment pressures please refer to Appendix I.

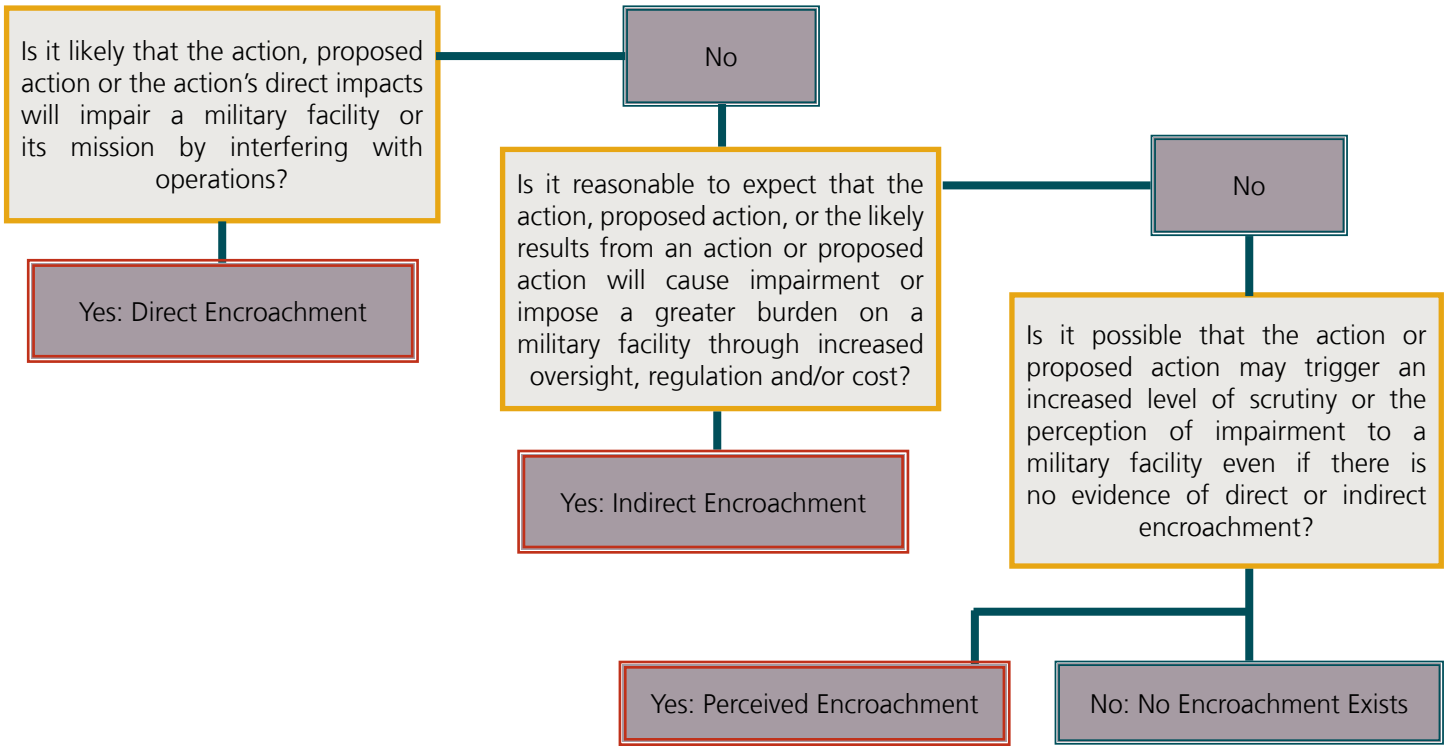
Davis-Monthan Air Force Base

This case study explores the impacts of urban development, a direct encroachment, into the operating area around Davis-Monthan Air Force Base in Tucson, Arizona. The community has been working for decades to establish a balance between the growth of the region and the need to preserve the military installation.

The Davis-Monthan Airfield was established in 1925 at Tucson's southern edge. At the time, this venture was considered the largest municipal airport in the country. During World War II, the airfield was devoted exclusively to military service and functioned as a training base for bombers. The airfield was renamed the Davis-Monthan Air Force Base (D-MAFB) in 1948. In the subsequent decade, the airfield served as a military training ground as well as a municipal airfield for commercial flights.

D-MAFB currently houses the 355th Fighter Wing aircraft along with its nine major units, including operations, maintenance, mission and medical support. At the national level, this military fighter wing is responsible for close air support, air interdiction, forward air control, combat search and rescue, ground based tactical air control, and airbase operations. Additionally, the 309th Aerospace Maintenance and Regeneration Group

Figure 6 - Decision-Matrix for Direct, Indirect, and Perceived Encroachment



(AMARG) manages the world's largest aircraft bone yard at D-MAFB. This facility serves as the parts reclamation site for all retired military and government aircraft worldwide.

Air Force base operations at D-MAFB respond to the following military aims:

1. Deploys, employs, supports, and sustains immediate airpower attack in support of Combatant Commanders anywhere in the world;
2. Trains attack pilots for Combat Air Forces; and
3. Provides every member of Team Davis-Monthan with responsive, tailored and mission-focused base support (U.S. Air Force 2015).

D-MAFB has contributed nearly $1 billion annually to the local economy of Tucson (Davis-Monthan Air Force Base 2014). According to the fiscal year 2013 economic analysis, 2,000 members of D-MAFB are stationed in combat zones around the world which demonstrates the impact of training operations as a value to military training and readiness. Additionally, the military base employs close to 3,000 Tucson-based civilians and has created over 4,000 additional jobs per year.

Mitigation Measures

The Arizona Military Regional Compatibility Project, a result of 2001 state legislation, encouraged the establishment of partnerships to develop solutions for military encroachment conditions statewide (Parsons 2006). One outcome was the Davis-Monthan Air Force Base/Tucson/Pima County Joint Land Use Study (JLUS), a comprehensive planning initiative that was implemented by a range of public policy-makers and non-governmental stakeholders.[5] The joint land use study planning process was developed to protect the missions of Arizona's military facilities from the impacts of urban growth; in this case to specifically protect D-MAFB from the impacts of urban growth in greater Tucson.

The JLUS addressed negative urban impacts including incompatible development, public safety, and noise complaints. The study also identified large tracts of undeveloped state trust lands to the east, south, and southeast of the military base (See figure 7). These lands were anticipated to be retained as valuable open space that could prevent this encroachment. However, large sections of state trust lands in southeastern Tucson were also slated to absorb much of the city's future growth. The JLUS proposed a dual solution: (1) explore creative mechanisms to protect thousands of acres of state trust lands in perpetuity; and (2) work closely with partner jurisdictions to

Table 3 - Direct Encroachment

Direct Encroachment Type	Impact
Incompatible Urban Development including residential, commercial, and public buildings	• Loss of civilian life and/or property • Complaints due to noise, dust, low flight altitude, etc. • Trespass of civilians into military bases and/or training facilities
Vertical Obstructions including solar towers, wind energy structures, communications towers, etc.	• Loss of military life and/or property • Loss of civilian life and/or property
Light Pollution	• Interference with military operations including military testing and training activities
Communication Interference	• Transmission lines, cell towers, and other electronic equipment can interfere with military testing
Outdoor Recreational Interference	•Certain recreational activities can impair airspace and create a threat to civilians and military lives and/or property
Border Security Activities	• Some border security actions occur on military facilities and interfere with training operations • Border security construction including observation towers and communications facilities can impair military operations
Trespass Livestock	• Loss of habitat value and character on the military facility • Livestock on military facilities can impair operations • Can compete with native wildlife that have specific management objectives

ensure compatible land uses for future urban growth areas. Of the twenty implementation actions proposed by the JLUS, half related to the creation of off-base buffers through tools such as fee-simple land acquisitions, conservation easements, and density transfers.

The Prevention of Urban Encroachment of Davis-Monthan Air Force Base program allocated $10 million to a military installation fund for state trust land purchases, which by law can only be sold at auction. Pima County confirms the organization has "spent all $10 million of the original authorization for 461 acres to prevent urban encroachment near Davis-Monthan Air Force Base. Eighteen parcels have been acquired." (Pima County) The military has also moved its firing range to within the BMGR installation and has transferred associated lands back to the state. D-MAFB also leases land from the city to enhance buffered areas. No other additional initiatives to purchase additional state trust lands as a buffer for the D-MAFB have been identified.

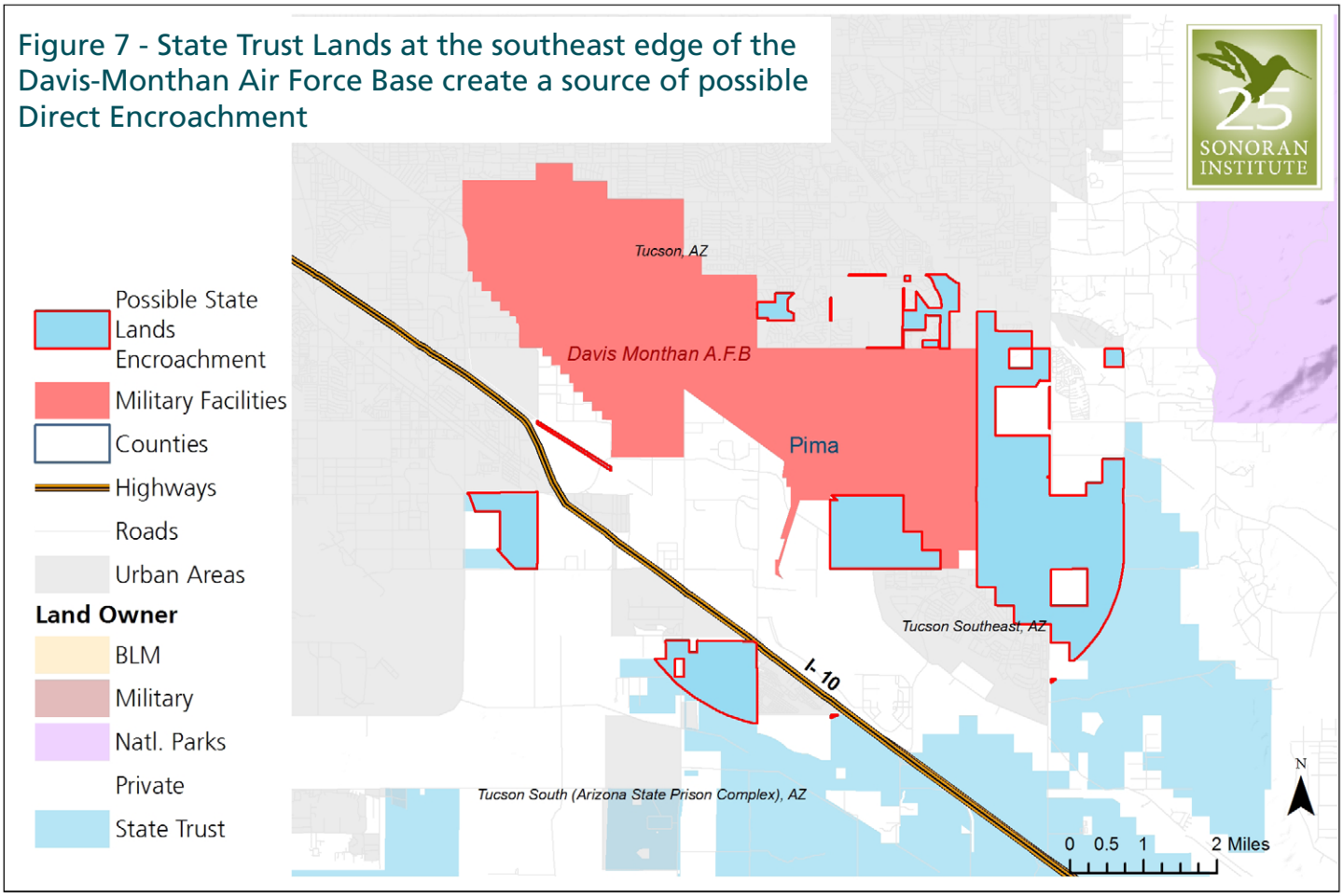
Continued Quality of Life Complaints

Quality of life complaints regarding D-MAFB operations primarily consist of noise pollution, land use conflicts, air pollution and flight hazards. For the most part, these complaints result from military operations that have a long-standing presence in the area, predating the development that surrounds the facility. Adverse impact complaints were reported as early as 1954 when the safety and compatibility of schools located within the D-MAFB flight path were first questioned (Parsons 2004). Compared to the surrounding Luke Air Force Base population in Glendale, the Tucson population surrounding D-MAFB has been more vocal. By comparison, in a recent reporting period, 760 annual complaints were recorded at D-MAFB compared to 100 complaints at the similarly urbanized Luke Air Force Base (D-MAFB Meeting Notes, 3 March 2015).

There is an active vocal minority that continues to challenge the existence of the D-MAFB in Tucson. Most complain about the impact that aircraft noise levels and low flying planes have on the quality of life and peace of surrounding communities. Military officials observe that more complaints have been fielded from the University of Arizona campus and patrons of the downtown Tucson business district than from neighborhoods immediately surrounding the base. They are confident, however, that buffers around the military installation exceed existing requirements of the State statute.

In a contrasting example, when the Julia Keen Elementary School, which actively functioned within the Accident Potential

Figure 7 - State Trust Lands at the southeast edge of the Davis-Monthan Air Force Base create a source of possible Direct Encroachment



Zone at the northwestern end of the runway since 1954, was closed by the Tucson Unified School District in 2006, some parents complained about having to bus their children to a distant school. Observers have noted that long-time Julia Keen neighborhood residents have not given much attention to living under the D-MAFB flight path. Despite efforts to exceed the land buffer requirements surrounding the Davis-Monthan Base, other factors still threaten continued military operations in Tucson.

Airspace Management

D-MAFB flight operations are performed at the Tombstone Military Operations Area (MOA) in Cochise County and at Barry M. Goldwater Range (BMGR) located some 157 miles southwest of the D-MAFB airfield. However, all assigned aircraft are either housed at D-MAFB, LAFB or at MCAS Yuma. The D-MAFB airfield also shares common airspace with the Tucson International Airport, located to the southwest of the D-MAFB airfield. Parallel distances between the two airfields approximate seven miles. Air space management in this area is at times referred to as "the tale of two runways." The airspace assigned to the two airports is co-managed by the U.S. Air Force (D-MAFB), the City of Tucson, and Pima County aviation administrators.

Noise and Land Use Encroachments

Operational impacts within or surrounding the D-MAFB cover an area of approximately 151 square miles. Of this breadth, approximately 65 square miles, or 40 percent of the designated sector consist of urbanized areas. Accident Potential Zones (APZs) were established on both ends of the airfield; however, 85 percent of flights still arrive and depart from the southeastern end of the runway (D-MAFB meeting notes, 3 March 2015). Due to wind patterns, noise transmission affects areas outside of buffer zones; however, the noise tolerance threshold remains 65db.[6] A minimal number of residential units are found within areas with measurements above 65 LDN (day/night average sound level). Commercial and industrial developments found within the western APZ exist within the crash zone areas, but are not impacted by aircraft noise levels as they are considered a compatible land use.[7] Boundaries for residential areas north of the eastern end of the runway were intentionally developed outside of the 65db designation. Other developed areas are mostly found along the northeastern end of the D-MAFB airfield and along the military bone yard outside of the higher decibel ranges.

Despite efforts to establish buffered areas around the military airfield, D-MAFB is surrounded by expanding Tucson residential communities, commerce and institutions. In particular, the University of Arizona and the Tucson Central Business District are located approximately 7.5 miles from the northwestern end of the runway. The greatest danger for this area appears to come from landing flights that approach the runway from the southeast. Occasionally, wind patterns also cause aircraft noise to travel in the northwestern direction.

Diminishing Property Values

Another form of direct encroachment, where the D-MAFB finds itself in an uneasy relationship with some outspoken members in the Tucson community, are concerns related to property values. In the areas surrounding the runway, they have diminished significantly due to land use restrictions that mostly attract industrial developments and industrial uses, which are deemed compatible with airport runways.

Summary

Over-arching regional concerns for D-MAFB include the maintenance of unrestricted airspace and training routes that connect D-MAFB aviators to other military sites, such as the BMGR. While these efforts have been largely successful, the continued resolution of these and other forms of direct and indirect encroachments, should be coordinated with statewide actions in order to more comprehensively protect military operations in urban Tucson.

> ***"Development of incompatible land uses in the area east, south and southeast of the Base could result in additional constraints on the Base's operations, and ultimately could lead to loss of part of the Base's mission or even its closure..."***
>
> Arizona Regional Compatibility Project—Davis-Monthan AFB/ Tucson/Pima County Joint Land Use Study (Parsons 2004, 4-2)

Indirect Encroachment

The most obvious and preventable source of impairment to a military facility or activity is direct encroachment, but indirect impacts from actions also put pressure on installations and their effectiveness. For this report, indirect encroachment is a condition whereby an action, proposed action, or the likely results from an action or proposed action will cause impairment or impose a greater burden on a military facility through increased oversight, regulation and/or cost. It can be difficult to foresee the impacts of an action, especially when it occurs far from military facilities and operations. For this reason, it is important to understand the concept of indirect encroachment and remain vigilant to reduce the occurrence of these impairments to Arizona's military community. The case study featuring the Barry M. Goldwater Range provides some context to the nature of this form of pressure. For a list

Table 4 - Indirect Encroachment

Indirect Encroachment Type	Impact
Habitat Loss and Fragmentation	• Development and disturbance activities on lands outside of military facilities and operating areas can result in increased wildlife management responsibilities and oversight • Endangered species may live on military facilities as a refuge of last resort due to fragmentation and loss of viable habitat elsewhere
Water Restrictions	• Urban development, mining, and other water intensive activities can cause impairment to military facilities especially if there is an threatened or endangered species impact
Invasive Species	• Activities can propagate the spread of invasive species onto military facilities
Loss of Natural Character	• Significant loss of natural landscape can remove the realism of the terrain, thereby reducing its effectiveness as a training area • Increased oversight and management responsibilities due to endangered species management
Loss of Natural Fire Regime	• Development impacts including transmission lines, roads and urban uses can restrict the natural fire regime
Attraction of Incompatible Wildlife	• Some development activities like solar photovoltaic panels can create a "lake effect" and attract birds that interfere with flight areas

of encroachment impacts categorized by the cause of the pressure refer to Appendix I. Table 4 identifies some of the occurrences of indirect encroachment on publicly-owned lands in Arizona.

Barry M. Goldwater Range

The Barry M. Goldwater Range (BMGR) is the "crown jewel" of Arizona's military training and operations portfolio. The landscape and features of the BMGR along with the proximity of this training area to bases of the Air Force and the Marine Corps allow for unparalleled quality in activities. Many leaders in the military community credit the BMGR for the continued success and expansion of Arizona's military mission. For this reason its preservation is crucial.

BMGR is split into two separately managed areas: the Air Force training range on the east side of the facility, and the Marine Corps range on the west side. Though these areas are managed separately for military operations, the issues related to encroachment broadly apply across the site. If a certain encroachment concern relates only to one section of the BMGR, it will be noted specifically.

The BMGR was established in the 1940's to provide aviation training services to Luke and Williams Air Force Bases located respectively in Glendale and Mesa (U.S. Department of the Air Force, Luke Air Force Base, U.S. Department of the Navy, Marine Corps Air Station Yuma 2012). Today, the 1.7 million acre range provides year-round flying and training conditions for some of the most advanced military procedures. Over 90 percent of all A-10 and F-16 pilots who fought in Operations Desert Storm, Allied Force, and Iraqi Freedom trained at the BMGR (Barry M. Goldwater Task Force 2005). Access to the BMGR training facility is now primarily shared by Luke and Davis-Monthan Air Force bases, respectively located in Glendale and Tucson, and the Marine Corps Air Station in Yuma, along with the Arizona National Guard Units located in Tucson and Pinal County. The recent introduction of the first of 144 supersonic F-35 Lighting stealth fighter jets to be stationed at Luke AFB and 88 of the Marine Corps variant to be stationed at MCAS Yuma is a significant victory for U.S. military operations in Arizona.

The DOD recognizes BMGR's significance by making it "indispensable" for producing combat ready aircrews as well as one of the nation's "most productive military reservations for training tactical aircrews" (U.S. Department of the Air Force, Luke Air Force Base, U.S. Department of the Navy, Marine Corps Air Station Yuma 2012, 1-2). Consequently, the BMGR range is strategically described as:

1. An isolated location within an appropriate training radius to nearby installations;

2. Protected by expansive undeveloped land and airspace;
3. Benefitting from clear air and weather patterns; and
4. Rugged terrain that provides diverse training opportunities and realistic training conditions. (U.S. Department of the Air Force, Luke Air Force Base, U.S. Department of the Navy, Marine Corps Air Station Yuma 2012)

Yet, the very qualities that make surrounding lands a critical military asset also make them increasingly valuable to wildlife escaping from urban development and associated infrastructure impacts. In certain situations, such as in Camp Pendleton near San Diego, California, military bases can find themselves in the undesirable position of being the "refuge of last resort" for endangered species with nowhere else to go (Richens et. al. 2013). This phenomenon is described in greater detail in Sonoran Institute's report, Strategies to Protect Arizona's $9 Billion Military Economy; Western Maricopa County Land Use Nexus. The over-arching concern is that since DOD lands harbor such an incredible density of threatened and endangered species, these military spaces are also at great risk for indirect mission encroachment due to wildlife management and other impacts.

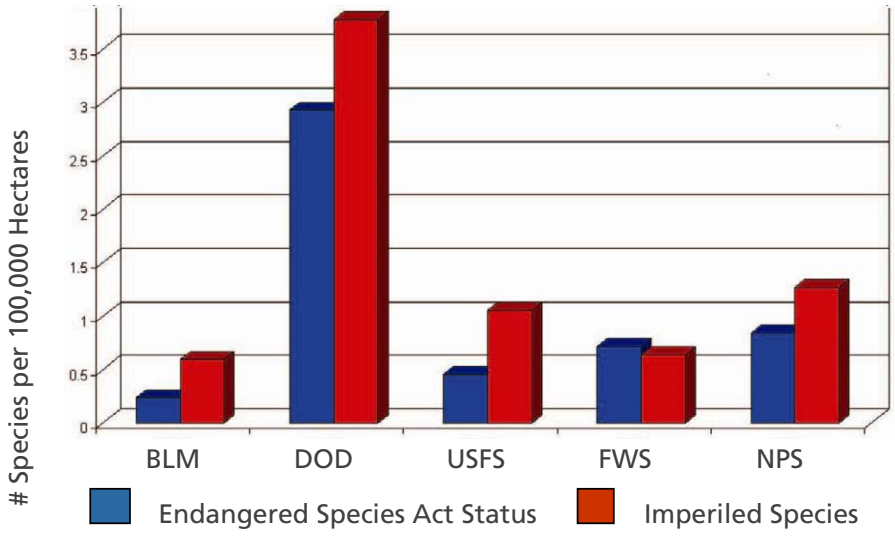
> ***"The effective size of the BMGR for supporting military aviation training is larger than its surface area would suggest as the restricted airspace that overlies the range to support aviation training has a surface footprint that exceeds that of the range by about 37 percent."***
>
> 2012 Update of the BMGR Integrated Natural Resource Management Plan

Indirect encroachment results from external forces that often have a cumulative negative effect on the military mission. In the case of indirect encroachment from wildlife impacts, these cumulative effects result in the cost of time, money, and other resources expended on wildlife management, as well as training delays, workarounds, or mission cancellations due to concern for wildlife nesting areas or migratory routes (Hagel 2014). Figure 8 offers a visual depiction of the magnitude of the DOD threatened and endangered species density compared to other federal land management agencies.

Officials at the BMGR are aggressively pursuing solutions that increase sensitive wildlife populations both on and off range to minimize these impacts and prevent the BMGR from becoming a refuge of last resort for threatened and endangered species. Under the guidance of its Integrated Natural Resource Management Plan (INRMP), the BMGR pursues an ecosystem management approach that "considers the environment as a complex system functioning as a whole, not as a collection of parts, and recognizes that people and their social and economic needs are part of the whole" (U.S. Department of the Air Force, Luke Air Force Base, U.S. Department of the Navy, Marine Corps Air Station Yuma 2012, 1-10).

One specific BMGR focus is on the management of large, intact ecosystems, accomplished through creative partnerships with diverse allies. For example, DOD managers work closely with the Arizona Game and Fish Department and the University of Arizona for assistance with relocating animals. Meaningful collaboration is partially by design: no fewer than eight distinct entities share in management and oversight responsibilities for the BMGR range and buffer lands (U.S. Department of the Air Force, Luke Air Force Base, U.S. Department of the Navy, Marine Corps Air Station Yuma 2012). These entities include the Secretaries of the Air Force and the Navy; Secretary of the Interior; the Commander of the 56th Fighter Wing at Luke Air Force Base; the Commanding Officer at Yuma Marine Corps Air Station; Arizona Game and Fish Department; and Cabeza Prieta National Wildlife Refuge Manager. The BMGR includes a significant 1.7 million acres of land, yet another 2.8 million acres of restricted military airspace is available to the base through compatible uses of adjacent public lands. As just one example, the Cabeza Prieta National Wildlife Refuge and Wilderness Area is managed to allow for a broader range of BMGR military aviation training needs (U.S. Department of the Air Force, Luke Air Force Base, U.S. Department of the Navy, Marine Corps Air Station Yuma 2012).

Figure 8 - Department of Defense Sensitive Wildlife Density[8]



(Source: Stein, Scott and Benton 2008 cited in Department of Defense 2014d)

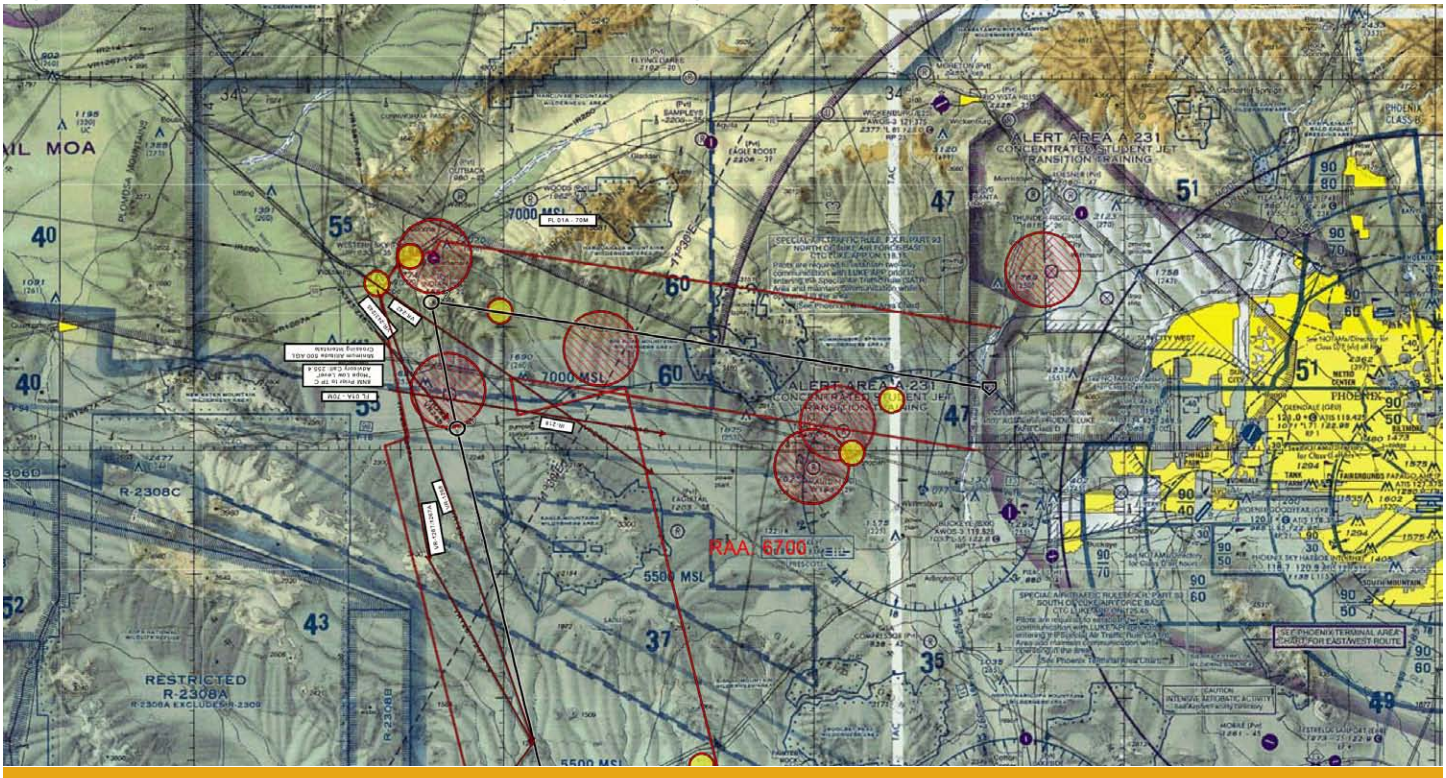
Figure 9 - Sonoran Pronghorn on BMGR (Courtesy Luke AFB)

Another primary reason for BMGR's focus on partnerships is due to the nature of its relationship with adjacent public lands. In the 2012 update of the Barry M. Goldwater Range INRMP, the following is acknowledged: "Parallel to its continuing value as an essential national defense asset, the BMGR is also nationally significant as a critical component in the largest remaining tract of relatively non-fragmented Sonoran Desert in the United States…[This tract] includes the adjacent, ecologically linked areas of Organ Pipe Cactus National Monument, Cabeza Prieta National Wildlife Refuge, and the Sonoran Desert National Monument…" (U.S. Department of the Air Force, Luke Air Force Base, U.S. Department of the Navy, Marine Corps Air Station Yuma 2012, 1-2) The INRMP continues by stating that these landscapes are interdependent and conserving functional ecosystems and biological diversity in one area benefits the others. The endangered Sonoran pronghorn (See Figure 9) provides one example of a species that requires coordinated management across connected landscapes (U.S. Department of the Air Force, Luke Air Force Base, U.S. Department of the Navy, Marine Corps Air Station Yuma 2012).

One final reason that the BMGR focuses on managing large ecosystems is due to the constantly changing context of global warfare. Simply put, technological advances are driving substantial shifts in the way wars are being fought. In a 2014 Report to Congress, the Secretary of Defense writes: "The expanding spectrum of training requirements and greater capability of weapons systems will increase demand for ranges to support multiple training missions… At the same time, the reality that a 21st-century battle space is measured in vast distances covered rapidly by highly capable forces increases the demand for extensive training areas and airspace that *exceed the limitations of a single installation*" (Hagel 2014, 4).[9] With the arrival of the F-35 to Luke AFB and Marine Air Station Yuma, it is increasingly important to provide an adequate training landscape for emerging and flexible missions.

The implications of this trend are enormous. The unrivaled open spaces and maneuver acreage provided by the BMGR, as buffered by public lands, provides airspace connectivity

Figure 10 - Encroachment Into Military Training Routes Connecting BMGR (Courtesy Luke AFB)



to adjacent military installations. As stated previously by the Secretary of Defense, superior military value is realized when bases are integrated. Despite such commendable efforts, encroachments on the BMGR continue to occur. An unfortunate example of direct and indirect encroachments are the slow but steady incursion of incompatible land uses into the Military Training Routes that originate near Tucson, Phoenix, and Yuma bases and enable low altitude ingress into the BMGR for realistic tactical deployment training. In some cases, these encroachments result in additional complaints and in other cases, they impair the habitat and ecological value of the interconnected landscape. Although many believe the vast public lands surrounding BMGR are sufficiently protected to ensure future connectivity, the reality is that those lands could be repurposed for other uses at some time in the future and that some uses are already in planning for the area including two solar energy zones on BLM lands north of the BMGR. Simply put, encroachments can "creep up".

Figure 10 demonstrates the issue of incompatible uses in flight corridors connecting Luke AFB to the BMGR. Red and yellow circles within these MTRs are avoidance areas resulting from encroachments like small airfields and urban development. As demonstrated by the red circles in figure 10, over time, competing land uses have made it so pilots can no longer fly a straight line through these corridors, but must maneuver around increasingly restricted airspace to complete their training missions. Furthermore, development activity such as construction, solar energy, mining and rock excavation on surrounding public lands is pushing wildlife onto military jurisdiction as a safe haven. Consequently, the continued establishment of land buffers and the management of natural resources on lands parallel to the military boundaries are indeed essential.

Perceived Encroachment

The preservation of the military mission is partially dependent upon the good reputation and perception of an installation and its unfettered access to training areas. In some cases, the merest perception of encroachment can result in increased scrutiny and oversight and can necessitate expensive mitigation measures. In many cases, the actual direct or indirect impairment that caused the condition has been resolved, yet the perception can remain for years. It has been said that "perception is reality" and in the case of military base encroachment it remains largely true. For this report, perceived encroachment refers to conditions whereby an action or proposed action may trigger an increased level of scrutiny or the perception of impairment to a military facility even if there is no evidence of direct or indirect encroachment.

For a list of encroachment impacts categorized by the cause of the pressure refer to Appendix 1. Table 5 identifies some of the occurrences of perceived encroachment.

Fort Huachuca

For two decades, Fort Huachuca and the surrounding community of Sierra Vista have been working to reduce the impacts of groundwater pumping on the aquifer that feeds the San Pedro River and supports the endangered Huachuca water umbel, a semi-aquatic perennial plant that grows there. This effort has been successful in-part due to the combined efforts of the Fort, the City of Sierra Vista, and Cochise County to implement conservation measures and active recharge projects (figure 11). Despite their best efforts, however, the success of conserving water has not entirely removed the perception within the community, environmental groups, or military officials that the Fort may be responsible for the ongoing concerns about water availability and the sustainability of resources in the San Pedro River valley. This case study explores the efforts of the Fort to reduce its impact on the water supplies and examines how the perception of encroachment can complicate the viability of a military facility.

Fort Huachuca, although at the cutting edge of military technological developments, is firmly rooted in the history and national heritage of the United States. As Arizona's oldest military base, Fort Huachuca enjoys a long history. In 1877, the United States military established Fort Huachuca near the San Pedro River with its abundant supply of flowing water. The Fort served as an outpost to protect new settlers from Apache raids. Some ranching families can still trace land ownership to the Homestead Act of the 1860's and continue to raise cattle in the desert grasslands surrounding the base.

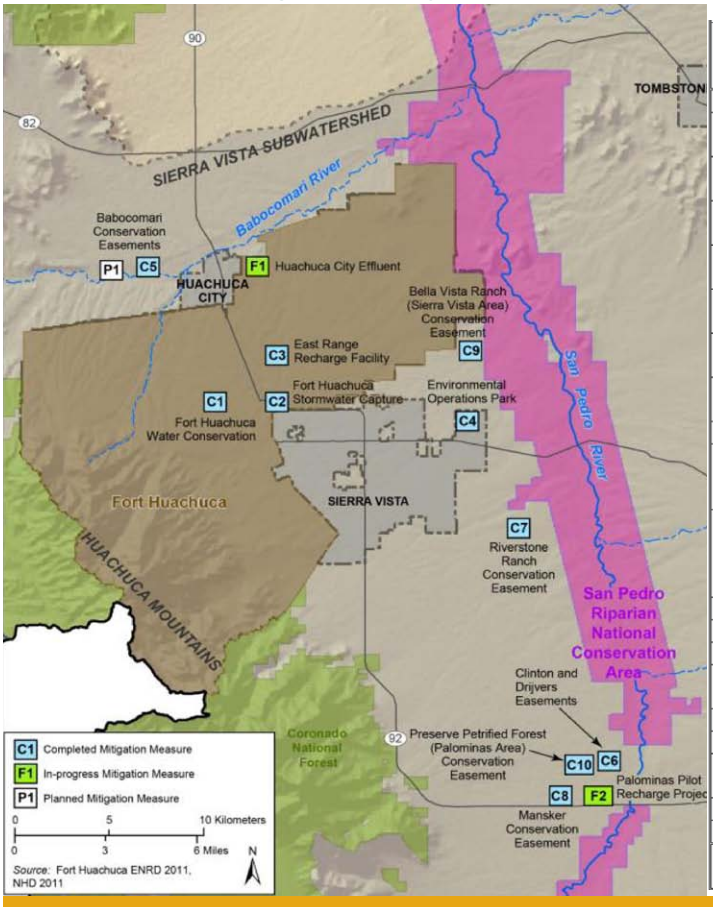
Beginning in 1892, Fort Huachuca housed every regiment of the original "Buffalo Soldiers", the collective nickname given to the first African-American members of the U.S. Armed Forces. From the 1950's onward, the Fort became a primary site for military electronics and communications testing due to unmatched weather conditions and the flexibility of the asymmetrical, multifaceted terrain (Pittman 2014). Fort Huachuca now houses the U.S. Army Intelligence Center. Current missions include "Command, Control,

> ***"... Fort Huachuca has proven itself as the U.S. Army's top installation working to conserve water supplies in the arid western United States... [the Fort] has gone from being a no-growth installation because of limited water availability to a sustainable installation that could feasibly double the size of its current mission..."***
>
> Senator John McCain (McCain 2014)

Table 5 - Perceived Encroachment

Perceived Encroachment Type	Impact
Past Encroachment Concerns	• Encroachment concerns that have largely been resolved can remain in the minds of the community and leaders at the Department of Defense
Non-encroachment Urban Uses	• Urban uses near military installations may not in-themselves be an encroachment concern, yet they can raise scrutiny and the perception of impairment
Large-scale Proximate Non-Urban Development	• Large-scale solar development, transmission lines, and other projects may create the perception of impairment
Proximate High Disturbance Impacts	• Mining, forest management operations, off-highway vehicle use, border security activities, and other impacts of high disturbance to the landscape can create a perception of impairment
Controversial Public Policy	• Occasionally, public policies of high controversy can impair nearby military facilities, especially when the public policy has high political backing and the military is at a comparably weaker position
Natural Resource Constraints	• If a region suffers from water shortages or other resource constraints, military facilities can be burdened by the perception of impairment

Figure 11 - Fort Huachuca Area Map Depicted with Groundwater Mitigation Projects (U.S. Fish and Wildlife Service 2014)



Designation	Project Name	Water Savings (AFY)	Acres of Easement	Dollars	Year Implemented
Completed Mitigation Measures					
C1	Fort Huachuca Water Conservation	1,998	N/A	N/A[1]	1990 – 2011
C2	Fort Huachuca Stormwater Capture	108	N/A	N/A[1]	2003 to 2007
C3	East Range Recharge Facility	368	N/A	N/A[1]	2002
C4	Environmental Operations Park	1,034	N/A	N/A[1]	2002
C5	Babocomari Area Easements	299	3,628	$9,433,000	2000-2011
C6	Clinton and Drijver Easements	1,073	1,063	$815,000	2000-2001
C7	River Stone Ranch	149	1,811	$3,001,000	2012
C8	Mansker Easement	24	285	$ 800,000	2013
C9	Bella Vista Ranch (Sierra Vista Area) Easement	238	2,893	$4,000,000	2013
C10	Preserve Petrified Forest (Palominas Area) Conservation Easement	2,588	640	$2,600,000	2013
	Total	**7,879**	**10,320**		
In-progress Mitigation Measures					
F1	Huachuca City Effluent	88	N/A	$10,100,000	2014
F2	Palominas Pilot Recharge Project	98	N/A	See C8	2015
	Total	**186**	**0**	**$10,100,000**	
Planned Mitigation Measure					
P1	Planned Babocomari Area Easements	248	3,000	$8,000,000	2014-2022
	Total	**248**	**3,000**	**$8,000,000**	
	GRAND TOTAL	**8,344**	**13,320**	**$38,759,000**[2]	

[1] The overall costs for these projects were not available.
[2] This total does not include costs for C1, C2, C3, and C4.

Communications, Computer, Intelligence, Surveillance, and Reconnaissance." (Department of Defense 2014b). Fort Huachuca is presently Cochise County's primary employer and contributes annually more than $2 billion to the economy of the region (Levinson and Shah 2011).

The Fort has long practiced progressive water conservation methods due to concerns about water scarcity and the potential impacts of groundwater pumping to endangered species on the San Pedro River, but conservation efforts have intensified over the last two decades. Some of these interventions address technology changes and rainwater capture, while others revolve around the protection of nearby lands (Cochise County Cooperative Extension 2015). Figure 11 shows the Fort's positioning in relation to the San Pedro Riparian National Conservation Area, as well as other conservation measures undertaken to protect groundwater resources.

Fort Huachuca's water usage has declined significantly over the past decade and the Fort reached a critical milestone in 2014: Rainfall and other natural sources of water are now replacing more water in local groundwater tables than the Fort's operations are consuming (McCain 2014). Figure 12 shows the benefits of Fort Huachuca's conservation measures.

As demonstrated by the referenced data, even with a steadily increasing population, the Fort has been able to reduce groundwater pumping from a high of 3,000 acre-feet in 1993 to under 1,000 acre-feet in 2012. As shown in Figure 13, Fort Huachuca is leading other Arizona communities in individual water conservation by an average of 52 gallons per capita per day!

These ever-improving water conservation statistics recently resulted in official recognition by the U.S. Fish and Wildlife Service (USFWS) that Fort Huachuca's operations no longer have a detrimental effect on critical habitat in the San Pedro or Babocomari rivers, which are recognized as sensitive riparian ecosystems harboring threatened and endangered species (U. S. Fish and Wildlife Service Press Release 2014).

Figure 12 – Groundwater Use at Fort Huachuca Compared to Population, 1992-2012 (U.S. Fish and Wildlife Service 2014)

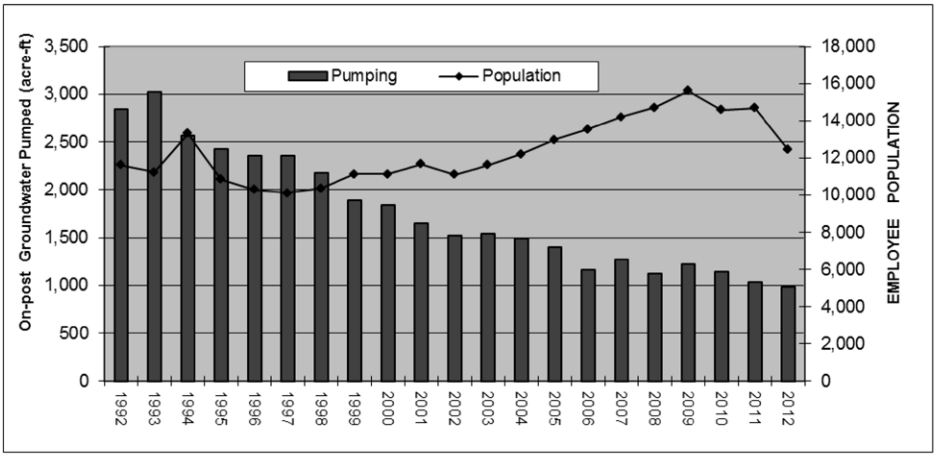
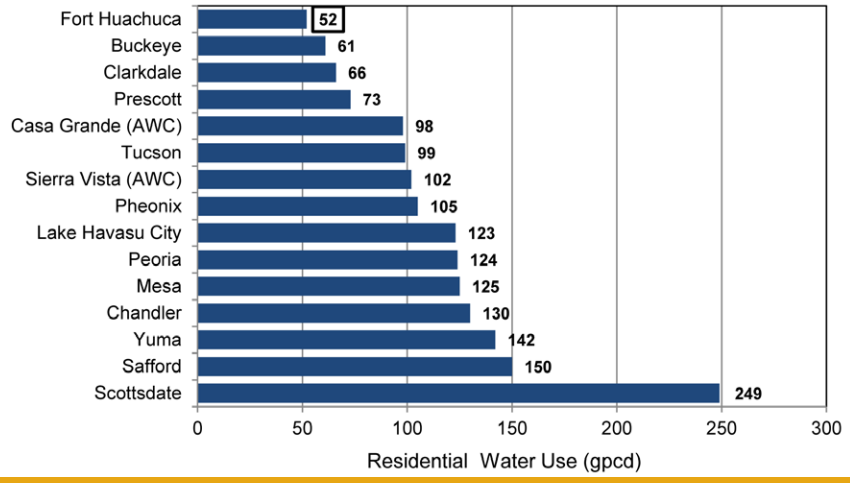


Figure 13 - Residential Water Use, Gallons per Capita per Day (U.S. Fish and Wildlife Service 2014)



Extensive lawsuits prior to the official USFWS ruling on water use violations, however, have left the Fort with an adverse reputation for unsustainable groundwater pumping activities. Consequently, local and national decision makers may perceive that water scarcity complaints put the Fort at risk. This situation is a good example of perceived encroachment. Although federal officials can attest that Fort Huachuca is not in a position to lose mission integrity due to water limitations, the perceived impact of water scarcity in the minds of decision makers may cause them to consider base closure and realignment decisions that are not founded on the true situation. For this reason, stakeholders and military advocates must remain vigilant and proactive in educating constituents on the facts.

In addition to its concern about water, the Fort has also prioritized addressing the encroachment pressures facing the integrity of its communications systems. Two buffer programs in particular have assisted Fort Huachuca in protecting its operations from adjacent private lands over the long-term. In 2007, the Fort first utilized the Army Compatible Use Buffer Program (ACUB) to create 1,400 acres of

conservation easements around the base. The benefits of this partnership are notable: cattle ranching can continue as can tax collection because the land remains in "productive use". Since the land doesn't change hands, the military does not incur costly management responsibilities. Consequently, the military mission for electronics and communications excellence is achieved or even enhanced (Metcalf 2007).

In addition, Fort Huachuca has emphasized creative partnerships to develop extensive off-base landscape buffers. The DOD's Readiness and Environmental Protection Integration (REPI) is another example of a more recent military buffer program that the Fort Huachuca has utilized to great success. In 2014, Fort Huachuca's REPI award totaled $4 million and protected almost 6,000 acres of grassland and 160,000 annual air operations. Moreover, the REPI award recognized the preservation of 800 square miles of airspace from electromagnetic encroachment and prevented up to 1,400 new wells from being drilled in the area surrounding Fort Huachuca (Department of Defense 2014c).

Most recently, in 2015, Fort Huachuca was awarded a Sentinal Landscapes Partnership designation which allows it to better preserve conservation lands around the facility. Additionally, the designation promotes enhanced multi-jurisdictional cooperation and collaboration with conservation initiatives to reduce the threats of incompatible uses and other encroachment pressures.

The Army is also currently planning another ACUB proposal to protect Fort Huachuca's Electronic Proving Ground from frequency spectrum encroachment (Hagel 2014). In 2013, a partnership was established between Fort Huachuca, Cochise County and the City of Sierra Vista to avert construction of two transmission line projects across Fort Huachuca's Buffalo Soldier Electronic Test Range, as proposed by the SunZia and Southline companies. These initiatives would have affected Fort Huachuca's ability to effectively use the electronic test range and negotiations succeeded in informing a better approach to development of these projects. By keeping the land free from development, including power lines, surrounding areas also remain free of electronic and aerial interference.

Tools to Protect From Encroachment

Research for this report demonstrated that the DOD has been proactive in developing tools to improve natural resource management and mitigate encroachment risks. The planning tools employed by the DOD often emphasize preservation of lands surrounding military bases, both to form buffer zones for wildlife as well as to maintain unimpeded airspace. These tools include DOD's Integrated Natural Resource Management Planning Processes, the Sustainable Ranges Initiative, Sentinel Landscapes, and the Army Compatible Use Buffer Program.

The Sikes Act of 1960, as amended in 1997, requires military facilities to consider a landscape-level approach to natural resource management through the development of an Integrated Natural Resource Management Plan (INRMP) that incorporates lands and management actions across federal and state jurisdictions. Additionally, the National Defense Authorization Act (NDAA) of 2014 "requires [the] Department of Defense to develop and submit to Congress a comprehensive plan to address training constraints caused by limitations on the use of available military lands, marine areas, and airspace in the United States and overseas" (Hagel 2014, vii). The Sustainable Ranges Report to Congress responds to this NDAA. These tools, among others, can be useful to help prevent encroachment pressures from natural resources, development, or other possible impacts.

The purpose of the Sustainable Ranges Initiative is to "maximize the capability, availability, and accessibility of ranges and training land by minimizing restrictions from external factors." (Knott and Natoli 2004, 13) In this case, the word sustainable is used to emphasize that training ranges must be maintained in a functional state. Maintenance of the ecological integrity of the landscape translates directly into training realism. One popular tool administered under the Sustainable Ranges Initiative by the Office of the Secretary of Defense is the Readiness and Environmental Protection Integration Program (REPI). REPI allows the DOD to enter into cost-sharing agreements with other entities to protect buffer lands surrounding military bases (Readiness and Environmental Protection Integration Program 2014). The amount of the award can vary, but it is frequently $50 million dollars annually. In addition to this basic concept, which provides a constructive framework for collaborative land protection, REPI awards funds of up to $5 million through their annual REPI Challenge. These awards go to military installations that are able to leverage substantial partner financing for the project and aim to protect vast landscapes.

The Army administers a similar program known as the Army Compatible Use Buffer (ACUB) program, allowing the DOD to enter into partnerships with outside entities to permanently protect buffer lands surrounding military bases. The ACUB program was developed in the 1990s, and was catalyzed by endangered species regulations for the red-cockaded woodpecker at Fort Bragg, North Carolina. The military training and land management changes required to ensure the survival of the woodpecker were so disruptive that military personnel found the entire mission in jeopardy. For this reason, in 1995, the Army used the authority under the Sikes Act to enter into a formal agreement with partner entities to share the burden of endangered species management (B. A. Stein 2008).

The cooperative agreement was called the Fort Bragg Private Lands Initiative, and was the first collaboration of its kind for the military. Fort Bragg, The Nature Conservancy, and the U.S. Fish and Wildlife Service were all parties to the agreement, and they worked together to negotiate land acquisitions, conservation easements, and development rights. Title to the property was generally held by The Nature Conservancy, while the Army provided most of the funding. As a component of the partnership, the Army gained access to training opportunities on portions of the acquired land that are compatible for such use (B. A. Stein 2008).

This innovative collaboration was so successful in protecting the red-cockaded woodpecker and aiding in the rebound of its populations, that in 2003 Congress institutionalized the partnership approach. The ACUB program is available nationwide to Army installations and is viewed as a way to promote cost-sharing and collaboration around large landscape wildlife and natural resource management (B. A. Stein 2008). As of 2013, ACUB had resulted in 160,000 acres of land protected from incompatible uses at 30 locations across the country (Hagel 2014).

As evidenced by table 6, the military utilizes many other tools to protect bases from encroachment pressures.

Table 6 - Encroachment Buffer Toolkit with Examples

DOD Buffer Toolkit (Elwood 2008)		Example[10]
Mission restrictions	Reduce the impact of activities so that their impact to the community is diminished. Careful consideration must be given to the cumulative impacts of these individual buffer decisions.	Fort Bragg, NC[11]
Joint planning and management	Cooperative land management across boundaries can have the dual effect of creating a buffer for both community and installation.	Eglin AFB, FL[12] Barry M. Goldwater Range, AZ[13]
Shared land-use	Reimbursable or by agreement. Temporary or permanent. Common in the North Atlantic Treaty Organization.	Cape Canaveral, FL[14]
Cooperative agreements	Funding is provided by multiple parties to pursue buffer acquisitions that benefit partner interests.	U.S. Army Garrison, HI[15] Camp Pendleton, CA[16] Joint Base Lewis-McChord, WA[17] Fort Bragg, NC[18]
Temporary or mobile restrictions	Land-use restrictions that are in place for a set amount of time or are rotated for most effect. Examples include internal restrictions on use of training areas that are used to allow restoration activities.	Camp Pendleton, CA
Transferable development rights	Obtain specific property rights to ensure compatible development in designated buffer.	Pima County Transfer of Development Rights Program
Land exchanges	Exchange control of excess military lands or rights for similar concession from private or public landowners where buffer development is required.	To date, no land exchanges have been effectuated under Proposition 119 in Arizona.
Voluntary acquisition	Purchase fee-simple property to ensure no development.	Fort Stewart, GA[19]
Legislative relief	Pursue specific legislation at the local, state and federal levels to restrict incompatible land-use or enable any of the buffer tools.	Farallon de Medinilla Bombing Range, Commonwealth of the Northern Mariana Islands[20]
Seek involuntary acquisition through eminent domain	If the public good can be justified sufficiently, acquire land or development rights from unwilling sellers.	No example known.

Compatibility Tools for Publicly-Owned Lands

The tools offered in table 6, though useful for many private and state land concerns, are not all suitable for resolving pressures on federal lands. The tools outlined in table 7 include some from table 6 and focus on those that are available to assist in removing encroachment pressures that were discussed in prior sections. Some provide a solution for a broader array of encroachments.

Table 7 - Additional Encroachment Pressure Removal Tools

Tool	Pressure	Use	Example
Land Exchanges	Urban Development (State) Solar Development (State)	Transfer of mission-critical lands from private/state ownership to federal ownership.	Proposition 119 in Arizona. Currently in the rule development stage. No exchanges have occurred to date.
Integrated Natural Resource Management Plans (INRMPs)	Recreation (Federal) Cultural Resource Management (Tribal) Natural Resource Management (Federal) Urban Development (State) Solar Development (State)	Can be used to focus recreation activities to areas of higher compatibility. Can be used to appropriately manage wildlife resources across the region.	The Barry M. Goldwater Air Force Range[21]
Joint Land Use Studies (JLUS)	Urban Development (State) Solar Development (State)	Can be used to focus solar development away from incompatible areas. Can be useful to guide regional planning processes to help steer state land development away from areas of incompatibility.[22]	The Fort Huachuca Joint Land Use Study (JLUS)[23] explores land uses across multiple jurisdictions around the installation.
Inter-agency Coordination	All Types	By improving coordination between land managers, incompatible uses can be prevented in many cases. There are occasions where encroachment pressures cannot be resolved due to lack of support or political will.	JLUS processes and the emerging Sentinel Landscapes Partnership designation
Public Relations	Perceived Encroachment (All types)	Ensure adequate communication to the public around a military installation to prevent inaccurate perceptions and avoidable miscommunications	Groups like Fighter Country Partnership that advocate for the protection of Luke AFB have a public relations mission that works to proactively reduce negative perceptions of the base.

Table 7 - Additional Encroachment Pressure Removal Tools (Continued)

Tool (Continued)	Pressure (Continued)	Use (Continued)	Example (Continued)
Permanent Conservation Actions (Wilderness, National Conservation Areas, National Monuments, National Parks, etc.)[24]	Urban Development (Federal)[25] Solar Development (Federal) Transmission Lines (Federal) Extractive Industries (Federal) Recreation[26] (Federal) Border Enforcement[27] (Federal) Natural Resource Management (Federal)	Generally, these actions immediately do the following: -Prevent the transfer or sale of the land -Remove the land from solar development leasing -Reduce the likelihood that transmission lines can be developed through the lands (Wilderness designations remove the possibility of virtually all development) -Remove the lands from mining exploration and development (many existing operations are "grandfathered in") -Require a higher level of recreation management -Reduce the risk of border enforcement impacts by establishing defined boundaries requiring enhanced operational awareness -Establish areas of high natural resource compatibility by ensuring that conservation areas are managed to reduce impacts	Protected lands around the Barry M. Goldwater Range enjoy many benefits from the adjacent Sonoran Desert National Monument and the Cabeza Prieta National Wildlife Refuge. These areas provide valuable habitat for species like the endangered Sonoran pronghorn, the Sonoran desert tortoise (a candidate for Endangered Species Act protection), and other wildlife. These areas are also unlikely to be developed with incompatible uses due to their level of protection. Some impacts resulting from border enforcement activities however, have occurred on lands including Wilderness near the U.S./Mexico border.
Collaboration	All types	Collaborative groups across public, private, and non-profit sectors can allow for early identification and resolution of encroachment pressures.	Western Regional Partnership (WRP)
Memorandums of Understanding (MOUs)	All types	A document that allows various organizations to support the military mission by agreeing to certain actions that implement portions of a JLUS and/or other planning strategies.	MOU between Kirtland AFB and the New Mexico State Land Department to implement portions of the JLUS.

Conclusion

Since the year 2000, the Sonoran Institute has pursued initiatives that recognize the economic significance of Arizona's military installations and the inherent challenges involved in managing secure military operations in the Sonoran Desert. The U.S. military's direct contributions to ensuring the protection of Arizona's unique natural legacy for future generations are also laudable. In order to preserve the integrity of the military mission and its $9 billion economic benefit in Arizona, management actions are urgently needed to preempt any adverse decisions that can affect the efficiency of future military operations in Arizona.

Within the context of the larger country, Arizona may not enjoy as many military installations as other states, but they are substantial and important facilities in the military training landscape. The Davis-Monthan bone yard operates as the world's largest parts and reclamation facility for retired military and government aircraft. Over 90 percent of all A-10 and F-16 pilots who fought in Operations Desert Storm, Allied Force, and Iraqi Freedom trained at the Barry M. Goldwater Range. While Fort Huachuca operates at the cutting edge of military technological developments for electronics and communications testing, it is firmly rooted in the history and national heritage of the United States' Western frontier. The arrival of the first of 144 supersonic F-35 Lighting stealth fighter (Figure 14) jets in 2014 (continuing over the next ten years) is a significant military operations victory for the Barry M. Goldwater Range and Luke Air force Base. Also, 88 F-35B fighter jets began arriving in 2012 to Air Station Yuma, where training for the Marine Corps version of the plane will be conducted.

This report defined various scenarios in which encroachments on military operations have occurred and how they can be resolved with the involvement of the diverse community of both military and civilian stakeholders. We also recognize that other public agencies could do more to facilitate the military's training sustainability. The three forms of intrusion to military operations are the following: (1) Direct Encroachment; (2) Indirect Encroachment and (3) Perceived Encroachment. We explored how various forms of public lands encroachments occur at select military bases ---Davis-Monthan, Fort Huachuca and the Barry M. Goldwater Range (including the Luke Air Force Base and the Yuma Proving Ground) --- to explain how this method of classification and management works, and included a survey of the management tools that could facilitate the continued reduction of various forms of encroachment from surrounding publicly-owned lands.

In future years, additional complexity is likely to contribute to the impairment of military installations across Arizona. Creative tool application that involves all land owners and managers is necessary to resolve challenges across the military landscape. In many cases, encroachments involving issues that are unrelated to the military mission will occur. Under these circumstances, the broader community needs to be vigilant to consider actions that will resolve encroachment pressures proactively. Currently, practical tools to resolve all impairments may not exist and should be developed as

Figure 14 - Luke Air Force Base Welcomes the First of 144 F-35 Airplanes (Courtesy Luke AFB)

circumstances require. Anticipating future impairments will allow the community to respond before threats become significant direct, indirect, or perceived encroachments and impair the military mission in Arizona.

Recommendations

Implement the Plans

Planning processes including Joint Land Use Studies (JLUS) and INRMPs are great collaborative tools to help protect military facilities and missions from encroachment. They are, however merely exercises in futility if they do not result in actions on the ground that proactively remove encroachment pressures. Recognizing this, some military facilities are working to go beyond planning by strategizing action plans that seek to implement the recommendations of the planning processes. A good example is the Kirtland Air Force Base Joint Land Use Study Implementation Project which identified the actions that were recommended by the JLUS and held the appropriate agencies accountable to put the plan into action. By using Memorandums of Understanding and other tools, many of the recommendations were implemented.

Recommendation 1, Review Planning Documents:

On a regular basis, Arizona's military facilities should review planning and compatibility reports to ensure that measures are being taken to implement the recommendations in the reports. Preferably, this review should occur with a diverse stakeholder group with broad representation in order to efficiently strategize action steps and assign tasks.

Recommendation 2, Create and Implement Action Plans:

Studies similar to the Kirtland Air Force Base JLUS Implementation Report should be accomplished for each military facility operating under a JLUS. This will allow for action steps to be identified and promote necessary accountability for each party to the process.

Be Vigilant

In many cases, development plans occur without notice to military officials who seek to preserve the viability of an installation or mission. Though federal and some state agencies are required to coordinate when actions occur in certain areas, many encroachments have occurred without notice to the appropriate individuals who are tasked with reviewing and providing input to the decision-making authority.

Recommendation 3, Assign Liaisons:

Each military facility should identify a liaison to communicate with incorporated cities and towns, counties, and government agencies responsible for reviewing and approving actions that could create encroachment pressures. The liaison should communicate regularly with these agencies, share planning materials like JLUS documents and relevant information and be prepared to provide input on proposed actions that could occur at a moment's notice.

Recommendation 4, Train Decision-Makers:

Decision-makers in communities around military installations, along with the relevant military community, should be trained to identify the full extent of the "mission envelope" and have a thorough understanding of the concepts of direct, indirect, and perceived encroachment. These training activities are essential in order to promptly and accurately identify pressures that could impact a military facility.

Broaden the Advocacy Network

Certain advocacy efforts around Arizona have been very successful in developing a broad base of proponents to preserve the military mission. Among the success stories include Fighter Country Partnership and the broadly adopted "Luke Forward" campaign that has resulted in impressive proactive measures to preserve Luke AFB in Glendale. Other actions are needed, however in order to address encroachment pressures that occur far from urban areas. In particular, attention is needed to promote threat reduction on federal lands where few businesses and city officials find alignment with their interests.

Recommendation 5, Create a Diverse State-Wide Coalition:

While some efforts have occurred to bring together a broad diversity of representatives to promote the preservation of the military mission, many relevant organizations do not recognize the value of participating. Often, the meetings and agenda is not perceived to be politically neutral nor is there an effort to ensure that the diverse community is invited to participate. In order for military facilities to achieve encroachment objectives, there must be a greater effort put into removing these barriers and gaining broader representation into military facility preservation.

Recommendation 6, Allow Creative Tool Implementation:

Various tools were identified in this report to reduce the risk of encroachment on military facilities and missions. Some of these tools, including the use of land exchanges and federal land designations, are creative approaches that may garner controversy from various stakeholders who are close to the issue. This does not, however, remove the value of implementing the tools when the need arises.

With many issues involving federal lands in particular, a broader advocacy network that includes conservation organizations could find value in developing pragmatic and well-reasoned approaches that serve to protect the military mission. This

type of collaboration should be welcomed by the military community. As an example, the Arizona Sonoran Desert Heritage Act of 2013 began as an attempt to protect natural lands on the western edge of Phoenix to primarily conserve natural and cultural resources with federal designations. Recognizing the value of the proposal for preservation of flight paths in and out of the Barry M. Goldwater Range, Fighter Country Partnership, along with other community leaders with military acumen, supported the plan. With collaboration across the diverse sectors of Arizona, it is likely that new approaches can be implemented that will serve to preserve military facilities without required investment significant time and energy from military officials.

Luke Air Force Base squadron F-16 Fighting Falcons fly in formation over base during a training exercise. (Courtesy Luke AFB)

Endnotes

[1]For purposes of this report, military training ranges are included in the "Military" category even though they remain owned by a Department of Interior agency.

[2]Email conversation with Michael Werner, Lands and Realty Specialist, BLM Arizona.

[3]Ibid.

[4]Ibid.

[5]The Policy Advisory Committee for this process included: the Arizona Department of Transportation; Arizona State Land Department; Tucson Chamber of Commerce; Tucson Airport Authority; local developers; a home builders association; a neighborhood association; two school districts; the University of Arizona; local, state, and federal elected officials; a municipal planning organization; a pro-military group; and the San Xavier District of the Tohono O'Odham Nation.

[6]The Federal Aviation Administration's Federal Aviation Advisory Circular AC 150/5020 refers to FAR Part 150, in accordance with the ASNA Act, which requires that each noise exposure map depict continuous Ldn noise level contours for the 65dn, 70dn and 75dn. The 65dn contour is described as the threshold of incompatibility for residential land uses.

[7]FAA Advisory Circular 150 details that different uses of land by people exhibit different sensitivities to noise. For example, schools, residences, churches, public health facilities, and concert halls often appear quite sensitive to noise. By contrast, factories, warehouse, storage yards and open farmlands are relatively insensitive to noise. Other uses such as offices, shopping centers, recreation areas, or hotels have intermediate noise sensitivity (FAA AC 150/5020-1, August 5, 1983).

[8]BLM = Bureau of Land Management; USFS = U.S. Forest Service; FWS = U.S. Fish and Wildlife Service; NPS = National Park Service

[9]Emphasis added.

[10]Examples of how the DOD Toolkit has been applied are based on the authors' research.

[11](B. A. Stein 2008)

[12](Jelks, Tate and Jordan 2011)

[13](Barry M. Goldwater Range 2012)

[14](George 2011)

[15](Natoli 2011)

[16]Ibid.

[17](Anderson 2011)

[18](B. A. Stein 2008)

[19](The Conservation Fund 2015)

[20](U.S. Department of the Navy 2008) *Note-this example is legislative relief from ESA compliance, but not due to encroachment (the bombing range is a tiny island in the middle of nowhere).

[21]http://www.luke.af.mil/shared/media/document/AFD-130823-073.pdf

[22]Joint Land Use Studies and land use recommendations that result, have limited impact on removing the pressure of development on state lands. In Arizona, there is no mechanism to conserve state lands and remove all development rights. Also, these lands enjoy "super zoning" authority in which development can be approved without the consent of the governing municipality.

[23]http://old.azcommerce.com/Military/Compat/Ft.+Huachuca+JLUS.htm

[24]Permanent conservation actions are enacted by Congress or in some instances, by the President of the United States under the Antiquities Act of 1906. They can only be applied to federal lands.

[25]Permanent conservation actions can remove the risk of urban development by ensure that the lands are not exchanged and brought into private and state ownership.

[26]Conservation designations do not remove the risk of all recreation activities but they generally require more cautious management actions. Some designations like Wilderness can remove the risk of off-highway vehicle recreation.

[27]Generally, border enforcement activities occur across the landscape regardless of the type of designation. Lands protected as Wilderness generally receive less impact though recent efforts in Congress are attempting to reduce the amount of environmental compliance that is required of these activities.

[28]http://azdailysun.com/news/local/govt-and-politics/lights-out-at-u-s-naval-observatory/article_0d2a08a6-fbff-5a42-bc9a-2c16d0d70d28.html

[29]http://ftp.fs.fed.us/psw/publications/documents/psw_gtr191/Asilomar/pdfs/93-100.pdf

[30]http://www.nationalgeographic.com/adventure/border-patrol/tim-cahill.html

[31]For a full timeline of Sonoran Institute's early engagement, please see Appendix A of the following report: http://azconservation.org/dl/TNCAZ_Sonoran_Initiative_Lessons_Learned.pdf

[32]Marshall, R.M., S. Anderson, M. Batcher, S. Cornelius, R. Cox, A. Gondor, D. Gori, J. Humke, R. Paredes Aguilar, I.E. Parra, S. Schwartz. 2000. An Ecological Analysis of Conservation Priorities in the Sonoran Desert Eco-Region. Prepared by The Nature Conservancy Arizona Chapter, Sonoran Institute, and Instituto del Medio Ambiente y el Desarrollo Sustentable del Estado de Sonora with support from Department of Defense Legacy Program, Agency and Institutional partners. 146 pp.

Appendix I - Encroachment Concerns by Type

Urban Development

Generally, urban development encroachment occurs on private lands near military installations or in areas of military use like Military Training Routes. Publicly-owned lands can also be subject to these pressures, especially state lands, which can only be conserved through a sale to a land trust or similar entity. State lands throughout Arizona are areas of significant concern for urban development encroachments due to the location of many parcels in relation to military facilities and the difficulty of removing them from development availability. On federal lands, development of urban uses does not occur, but parcels of significant value are occasionally exchanged or sold to convert them to development uses.

Encroachment Pressure: Significant impairment possible

Urban Development Encroachments		
Direct	Indirect	Perceived
Homes and commercial uses can cause significant challenges for military facilities and operations. Complaints from the public are catalogued and used as a metric to measure the viability of an installation. Lands with development potential including private and state-owned parcels are considered an encroachment pressure even if no plans are in place to develop them. Military operations that use optics, like the U.S. Naval Observatory in Flagstaff can experience direct encroachment from light pollution that can severely impair their viability.[28] Proximate urban uses can cause: -Dust -Light pollution -Trespass issues -Smoke -Noise each of which can impact the facility nearby.	On occasion, the development and infrastructure that serves it, can damage and fragment habitat to such a degree that wildlife must rely on nearby natural lands within military installations to survive. Urban demands upon natural resources cause impairment to military facilities. Much of the problem surrounding Fort Huachuca and the water constraints is related to urban development surrounding the installation.[29] Urban development brings communication infrastructure that can interfere with military electronics and communication testing, training, and experimentation activities.	In many cases, urban development encroachments are resolved after a period of public scrutiny and long-standing conflict. In these situations, the concerns, though largely removed, remain in the minds of the community and parties at the DOD. It can be difficult to remove these perceptions of encroachment. Urban uses near military installations can raise concern from the community and/or military leaders even if they comply with encroachment protection requirements.

Benefit: Conditional

Most urban uses are not compatible with military facilities and operations. In some cases, creative development planning and design can bring beneficial use to parcels within buffer zones or under special use areas. Some industrial development, golf courses, and other low intensity uses may be appropriate in areas of concern.

Renewable Energy Development

Over the past decade, renewable energy projects have become a large component of federal land management. In response to hundreds of thousands of acres proposed for large-scale solar projects, the BLM developed the Western Solar Program in 2012 covering six southwestern states including Arizona. Additionally, the Arizona BLM office implemented the Restoration Design Energy Project in 2013 that provided further direction on which lands were deemed appropriate for solar development across BLM, state, and private lands. These two projects established the solar energy program on BLM lands in Arizona by identifying three solar energy zones and over 1.8 million acres combined that is likely suitable for solar development across the state on federal, state, and private lands.

Recently, solar projects near Quartzite, Arizona have been the subject of controversy regarding the impact of the vertical towers on military operations. Two projects have been proposed in the area including the Solar Reserve project featuring a 653 foot tower on BLM lands and the "Enviromission" project that could be as tall as 2,500 feet on State Trust Lands. The military community has raised concerns about the possible impacts both projects could have on the military mission.

Encroachment Pressure: Variable; determinate on technology type and location

Renewable Energy Development Encroachments		
Direct	Indirect	Perceived
Solar towers located in flight corridors or military airspace can pose a vertical obstruction. Both solar and wind projects may cause interference with electromagnetic equipment and testing operations. Wind energy towers located in flight corridors or military airspace can pose a vertical obstruction.	Large developments of renewable energy can disturb habitat thereby encouraging wildlife to live on nearby military lands. Solar arrays can cause a "lake effect" and attract large birds to military operating areas thereby increasing the risk for bird strikes. Water intensive solar projects could impact military installations in areas where water is constrained or subject to management scrutiny.	On occasion, the development of renewable energy projects may pose no real encroachment pressure but may increase the amount of scrutiny of the viability of military installations and operations.

Benefit: Conditional

Renewable energy development can be an encroachment pressure if it is poorly sited. On the other hand, it can be hugely beneficial when used as buffer for a military installation in the right location. Solar projects that are low-lying and well sited can fill lands that would otherwise be left vacant, thereby bringing value to the community and the landowner. Renewable energy projects should be in the toolbox as opportunities for beneficial use of buffer lands.

Transmission Lines

Electrical transmission lines are a necessity of modern life. The Arizona landscape hosts significant amounts of transmission infrastructure that move energy from sources like solar, nuclear, and natural gas plants toward demand centers. These infrastructure corridors often extend across federal lands. As a general rule, transmission lines pose limited risk to military operations due to their relatively low elevation. In some cases, however, transmission lines interfere with military communication or may impact low-flying military maneuvers. Recently, the White Sands Missile Range in New Mexico opposed the development of the SunZia transmission line connecting wind energy areas to load centers in Arizona. Their concerns related to the possibility that missile testing could damage the line, electromagnetic interference could impair the use of the facility, and the line could be an obstruction to their operations. (Vestal 2014) As a result of negotiations, a compromise was reached, requiring underground placement of some of the powerline.

Encroachment Pressure: Variable; determinate on military facility and location

Electrical Transmission Encroachments		
Direct	Indirect	Perceived
In some locations, vertical obstructions like transmission lines can reduce the ability of the military to fly certain maneuvers or move ground equipment. Transmission lines can emit electromagnetic interference that can reduce the ability for military testing and communication.	Transmission lines can fragment desert habitat thereby creating challenges for wildlife. In some cases these animals may seek less disturbed lands on military installations or ranges. Roads along transmission lines become corridors for recreation that can facilitate the propagation of invasive species into natural areas and nearby military installations. Transmission lines can interfere with the natural fire regime thereby causing widespread environmental harm to nearby natural areas.	Multiple lines near or on installations could contribute to the perception that the facility is impaired.

Benefit: None

Extractive Industries

Extraction activities, including forest products harvesting and the mining of hard rock, metals, and aggregate are carried out on public lands throughout Arizona. In some cases, oil and gas development could also occur. These activities are permitted individually and occur in the location where the resources are found. For this reason, it is difficult to proactively guide development to areas that are appropriate for this use. On occasion, extractive activities can pose encroachment pressures to military facilities and missions and should be evaluated on a case-by-case basis.

Encroachment Pressure: Variable; determinate on military facility, location, and type of encroachment

Extractive Industry Encroachments			
Type	Direct	Indirect	Perceived
Forest Products Harvesting	In some landscapes, publicly-owned lands may be locations for on-the-ground military training maneuvers. These activities will occur on a limited basis, but require the landscape to maintain natural character. Significant amounts of logging could remove the natural character and reduce the benefit of the landscape for this use.	Activities can, on occasion, present indirect impacts by removing important habitat for wildlife. Roads needed to access logging sites can facilitate the propagation of invasive species into natural areas and nearby military installations and create conflicts with recreation use.	Intensely disturbing activities like logging can raise the level of scrutiny on military installations that are proximate to the activity area.
Mining and Aggregate Extraction	In some landscapes, publicly-owned lands may be locations for on-the-ground military training maneuvers. These activities will occur on a limited basis but require the landscape to maintain natural character. Significant amounts of extraction activity could remove the natural character and reduce the benefit of the landscape for this use.	Mining activities can create impacts to wildlife habitat that increase the amount of fragmentation and encourage the migration of species to undeveloped adjacent lands like military installations. Roads and increased travel through natural areas can facilitate the propagation of invasive species into natural areas and nearby military installations.	Intensely disturbing activities like mining can raise the level of scrutiny on military installations that are proximate to the activity area.
Oil and Gas Extraction	In some landscapes, publicly-owned lands may be locations for on-the-ground military training maneuvers. These activities will occur on a limited basis but require the landscape to maintain natural character. Significant amounts of extraction activity could remove the natural character and reduce the benefit of the landscape for this use. Towers, drills and other vertical components can cause issue with military training maneuvers and other activities. Some activities may cause interference with military equipment, testing, and/or operations.	Extractive activities can create impacts to wildlife habitat that increase the amount of fragmentation and encourage the migration of species to undeveloped nearby lands like military installations. Roads and increased travel through natural areas can facilitate the propagation of invasive species into natural areas and nearby military installations.	Intensely disturbing activities like oil and gas extraction can raise the level of scrutiny on military installations that are proximate to the activity area.

Benefit: Conditional

Some extraction activities, if appropriately sited and designed, could benefit military installations. Near Flagstaff, Arizona logging activities are intended to improve the watershed and reduce the pressure of destructive fires and habitat loss. Additionally, some extractive projects sited in buffer lands of state or federal ownership could make positive use of buffer lands with low environmental value.

Recreation

Recreation activities occur throughout publicly-owned lands in Arizona. Generally these activities are welcome due to their contribution to the economy and their benefit to a healthy lifestyle. Some recreation activities, however, can create impacts on installations and military missions if they are poorly managed or bring certain encroachment risks.

Encroachment Pressure: Variable; determinate on military facility, location, and type of encroachment

Recreation Encroachments			
Type	Direct	Indirect	Perceived
Off-Highway Vehicle (OHV) Recreation	Occasionally, OHV use can stray into military operation areas, especially in instances where military ranges were previously public lands that have been withdrawn for military use. The Barry M. Goldwater Range East and West both issue recreation permits to help manage recreation activities and ensure compatibility.	Poorly managed OHV recreation can fragment habitat and facilitate the migration of species to nearby natural landscapes like military lands. OHV use can facilitate the propagation of invasive species into natural areas and nearby military installations.	OHV use around installations can create the impression that there may be security risks and/or competing desires for the use of the land.
Recreational Shooting	Recreational shooting near installations and training ranges can present challenges for low-flying aircraft and other military operations.	Shooting areas near military facilities may cause changes to training procedures.	Shooting activities near installations may create the impression that military personnel and/or equipment is in danger.

Benefit: Conditional

Recreation activities on publicly-owned lands around military installations can promote a good-neighbor relationship and advance public relations strategies. The recreational permit process on the Barry M. Goldwater Range is an example of a strategy that seems to be a successful integration of the use. In most cases, recreation can occur around military activities with no conflict and can even enhance the beneficial use of buffer lands with high environmental value. Management actions are necessary to ensure the appropriate use of these areas.

Border Enforcement

Over the past decade, increased border enforcement activities have occurred on publicly-owned lands around the U.S./Mexico border in Arizona. These activities have contributed to increased levels of border security that are evidenced by decreases in Border Patrol apprehensions in Arizona over the past few years. (Ortega 2013) While these successes should result in improved safety and immigration controls, there have been significant concerns raised about the impact of these activities on natural lands and military facilities in the area of influence. Currently, there is a multi-agency agreement in place that allows border security activities to occur even in areas of high environmental value like Wilderness areas. Occasionally these activities can stray into military operation areas like the Barry M. Goldwater Range.

Encroachment Pressure: Variable; determinate on military facility, location, and type of encroachment

Border Enforcement Encroachments			
Type	Direct	Indirect	Perceived
Border Patrol Structures/ Fences	Occasionally, the Department of Homeland Security requests the development of additional communication and/or observation towers that may impair the operation of military activities.	Walls and/or fences that impede the migration of species across the U.S./Mexico border may contribute to increased wildlife management requirements on military facilities. Towers and structures can contribute to the fragmentation of wildlife habitat resulting in wildlife migrating to nearby natural areas like military facilities.	Border security activities and publicity can create the perception that military facilities within the region are at risk.
Border Security Activities	Border security activities occasionally stray onto military facilities. On these occasions adjustments to operations and training procedures may be required.	Border activities have caused significant environmental degradation on certain public lands. The Cabeza Prieta Wildlife Refuge has well-documented impacts from vehicle incursions by border crossers and pursuers from the Border Patrol.[30] These activities have an indirect impact by encouraging the migration of wildlife including the endangered Sonoran pronghorn onto the Barry M. Goldwater Range.	The controversy surrounding border security activities can result in increased scrutiny on military operations and facilities near the U.S./Mexico border.

Benefit: Conditional

Increased border security that reduces or prevents border incursions can be beneficial to military installations by reducing the amount of traffic that occurs on military lands and by preventing the environmental harm that may result.

Natural Resource Management

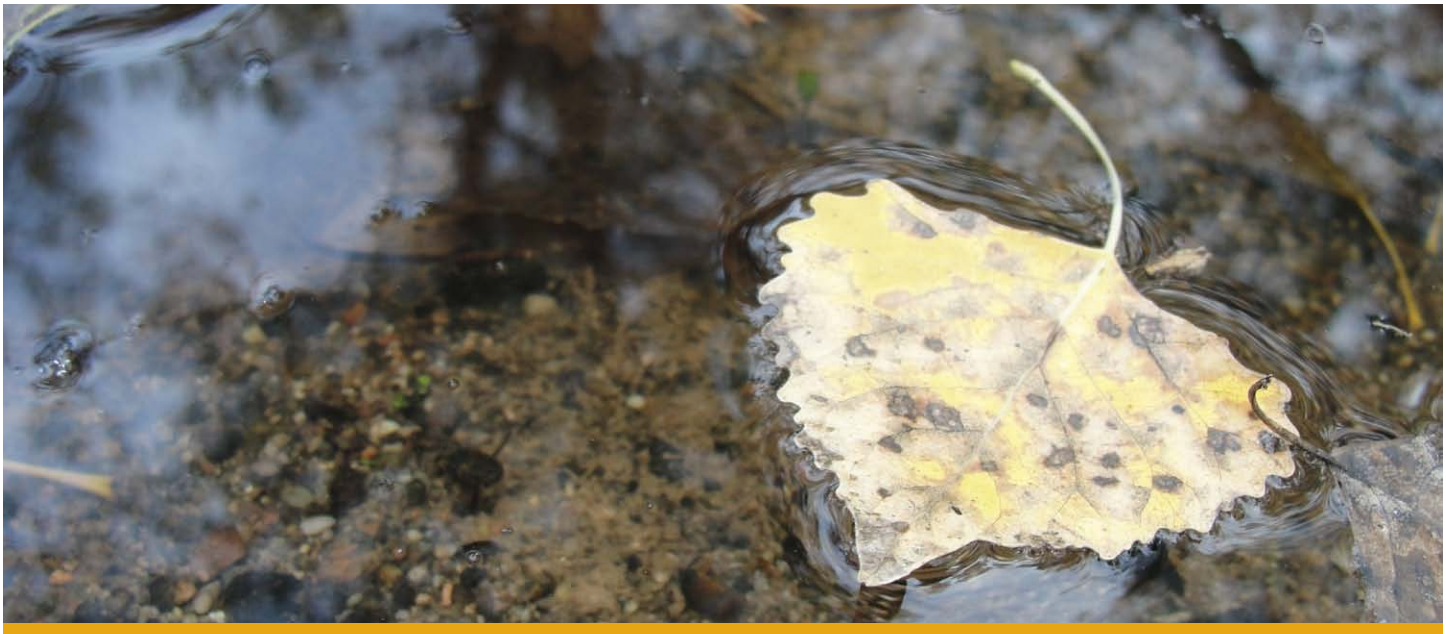
Often, publicly-owned lands are havens for natural resources including wildlife, riparian areas, unique vegetation, and other features. The management of these resources rarely occurs solely on these lands and often extends throughout the region depending on the issue. In some cases, the protection of natural resources extends into military facilities through increased responsibility to manage endangered species or to prevent increased degradation of the connected landscape. Some examples of this are noted in the case studies section of the report including the management of the Sonoran pronghorn on the Barry M. Goldwater Range and restrictions to water use on Fort Huachuca. The 1960 Sikes Act provides the framework for military installations to develop Integrated Natural Resource Management Plans (U.S. Fish & Wildlife Service) that are used to coordinate environmental management activities.

Encroachment Pressure: Variable; determinate on military facility, location, and type of encroachment

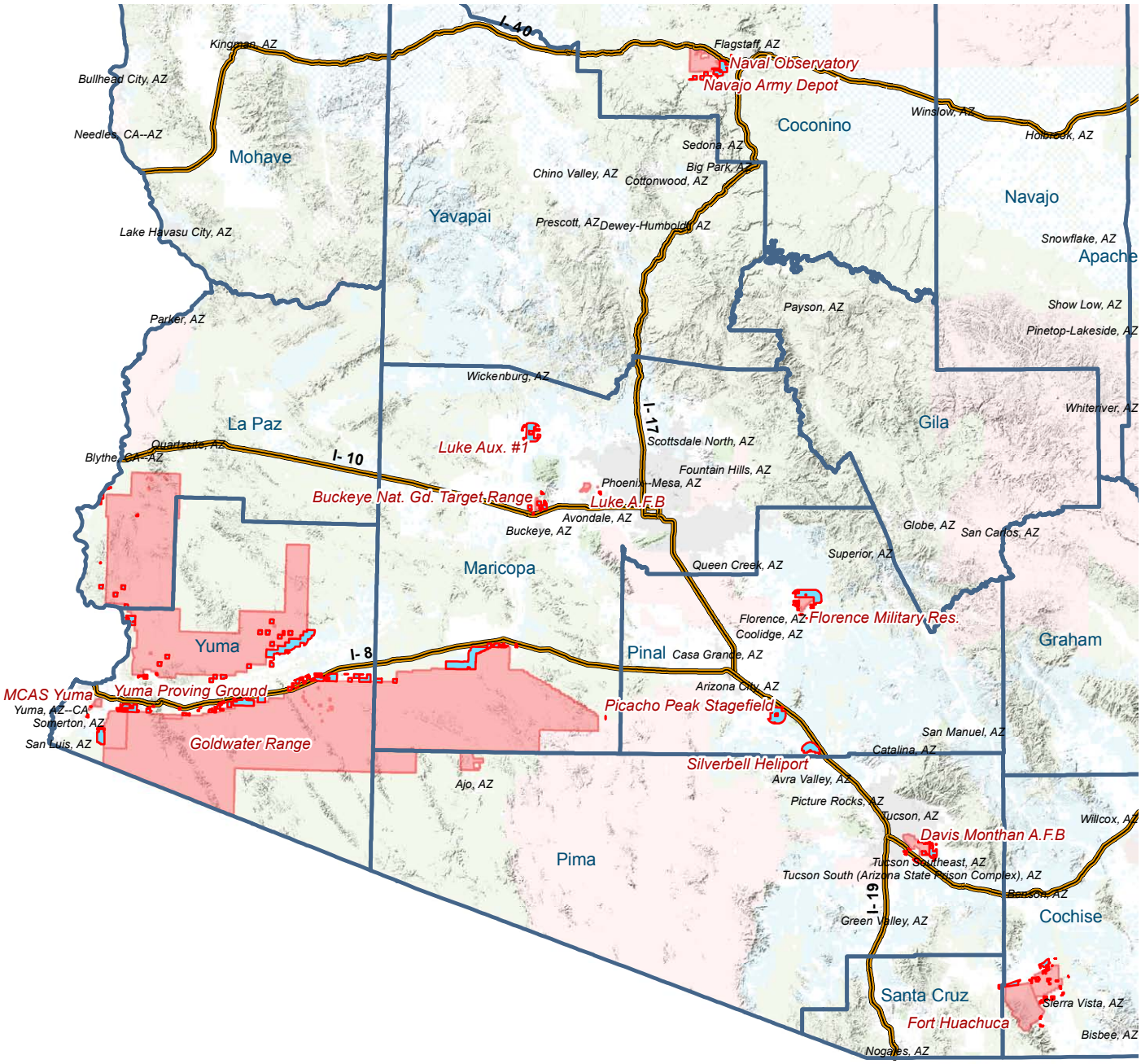
Natural Resource Management Encroachments			
Type	Direct	Indirect	Perceived
Threatened and Endangered Species (T&E) Management	The management of T&E species can cause operational impairment on military installations. Occasionally activities must be halted or reconfigured to respond to changing migration patterns or other animal behaviors.	Management of an endangered species may impact nearby installations that are not the physical home of the plant or animal of interest. Long-term drought and constrained water supplies can cause encroachment issues on military facilities due to requirements to change procedures and approaches in response to regional management goals.	Reports of endangered species management concerns and increased controversy around natural resource management can create the perception of encroachment on military facilities. Resource constraints near military facilities can create the impression that the site may be impaired.

Benefit: Conditional

Management of natural resources on military facilities is a necessary component of the modern military landscape. Proper public awareness actions can demonstrate to the public that the military is performing a stewardship function and is benefiting the environment through their actions. Additionally, appropriate advocacy by military leaders can help to bridge complex and controversial issues by demonstrating reasonable and pragmatic approaches to resolving these them.



Appendix II - Possible Locations for Encroachment on State Trust Lands near Military Facilities in Arizona



State Trust Lands

Counties
Possible State Lands Encroachment
Highways
Military Facilities

Urban Areas

AZ Land Own Detail
Land Owner
BLM
Forest

Indian Res.
Local or State Parks
Military
Natl. Parks

Other
Private
State Trust
Wildlife

0 10 20 40 Miles

N

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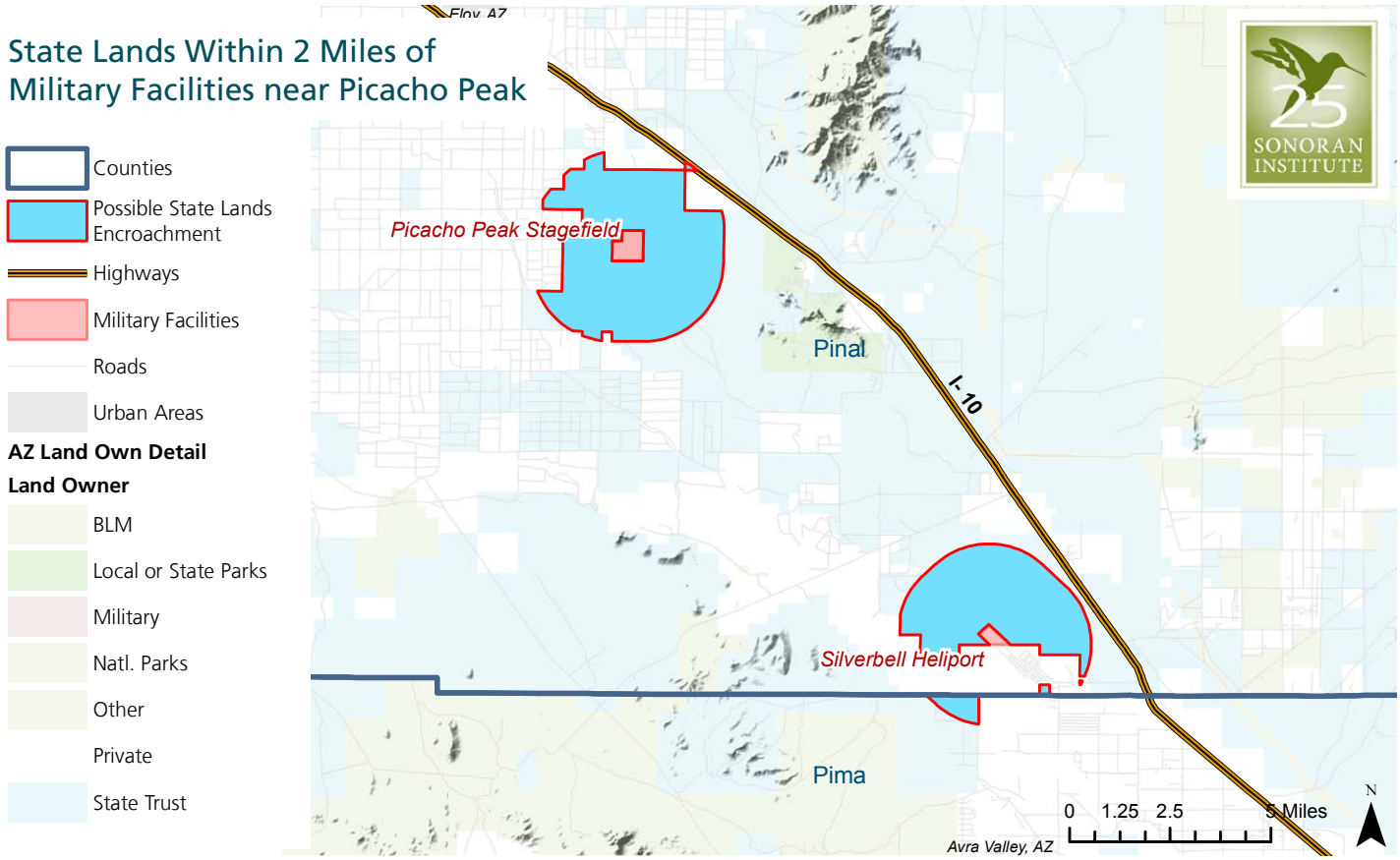
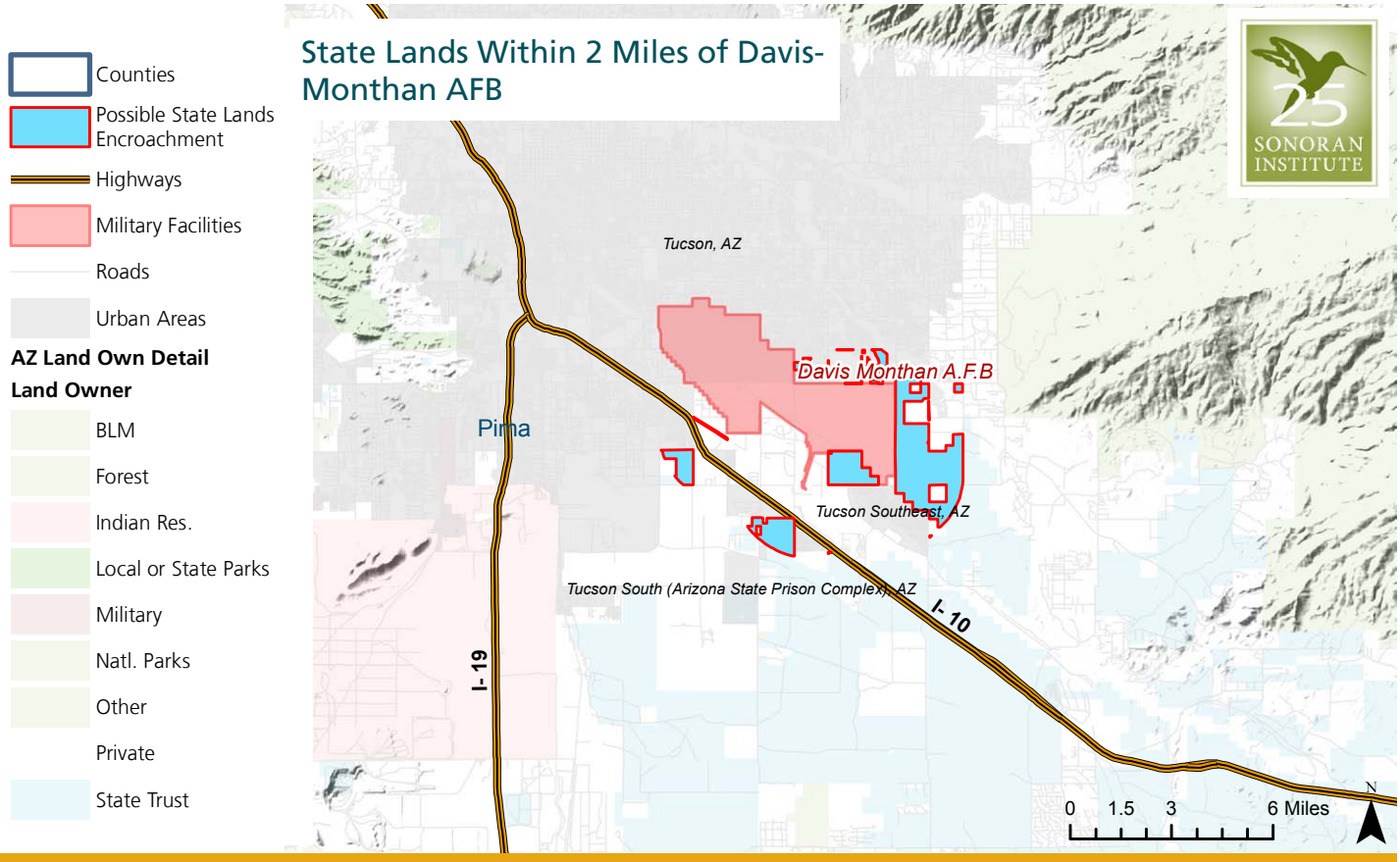
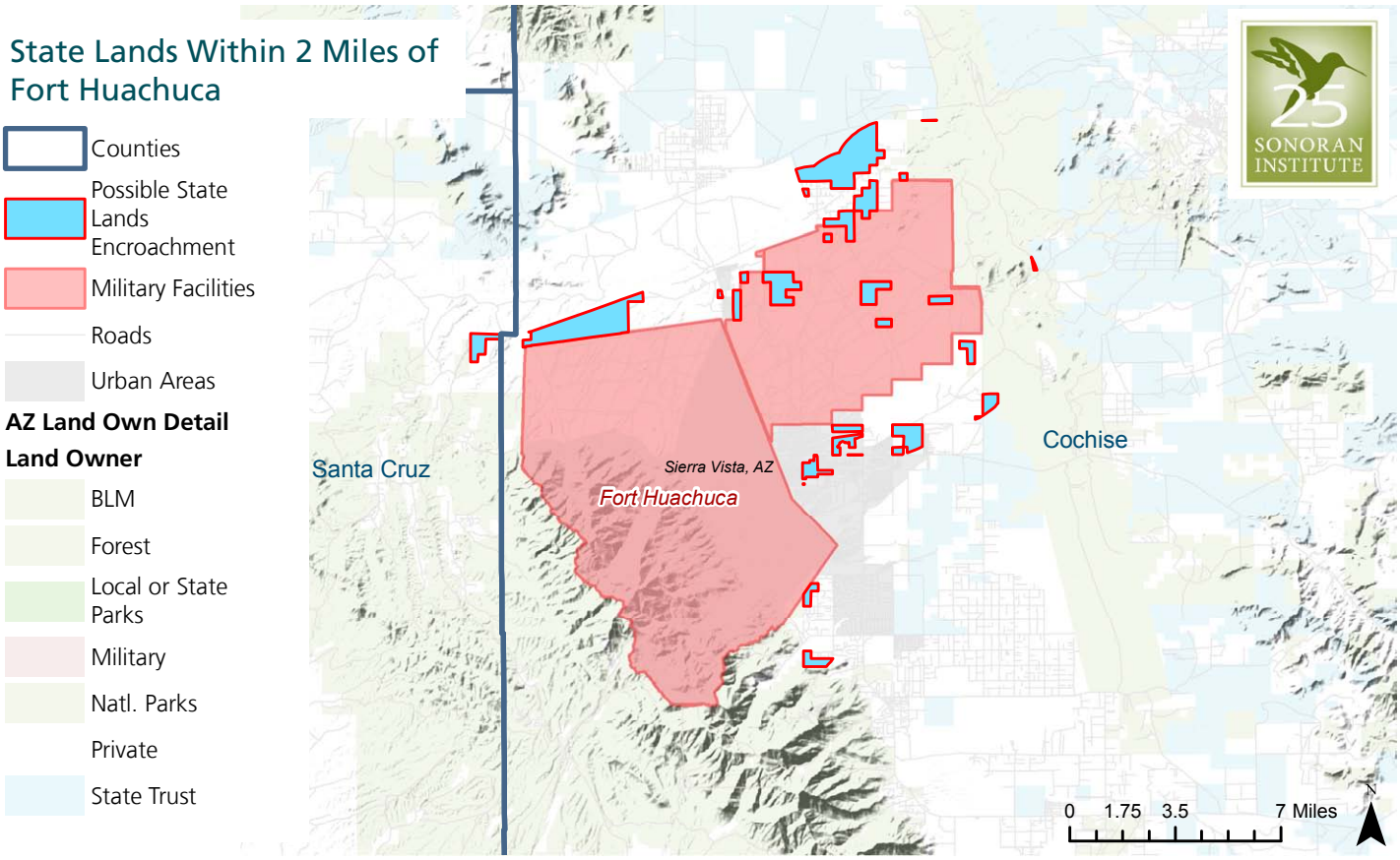
State Lands Within 2 Miles of Military Facilities near Picacho Peak



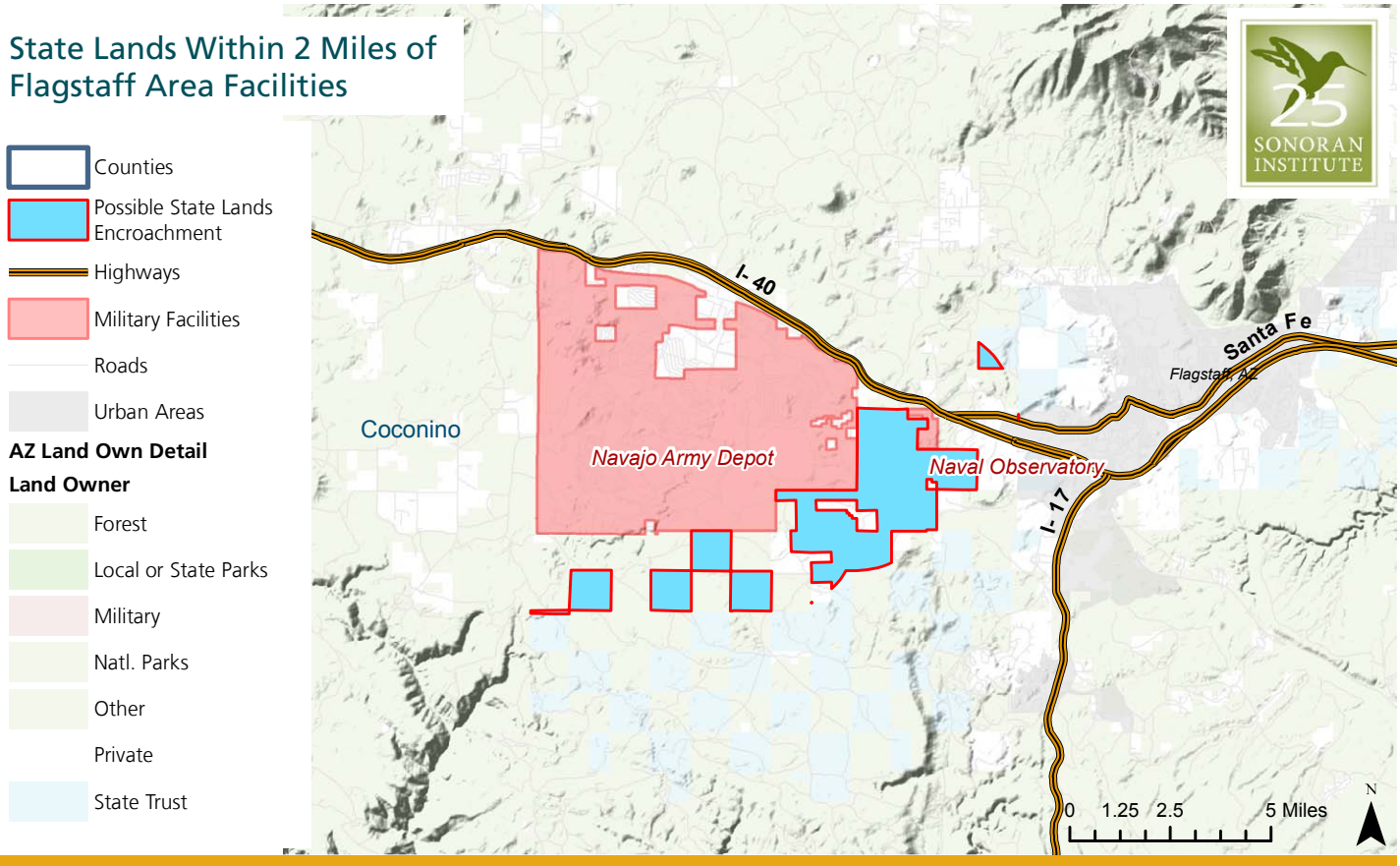
State Lands Within 2 Miles of Davis-Monthan AFB



State Lands Within 2 Miles of Fort Huachuca



State Lands Within 2 Miles of Flagstaff Area Facilities



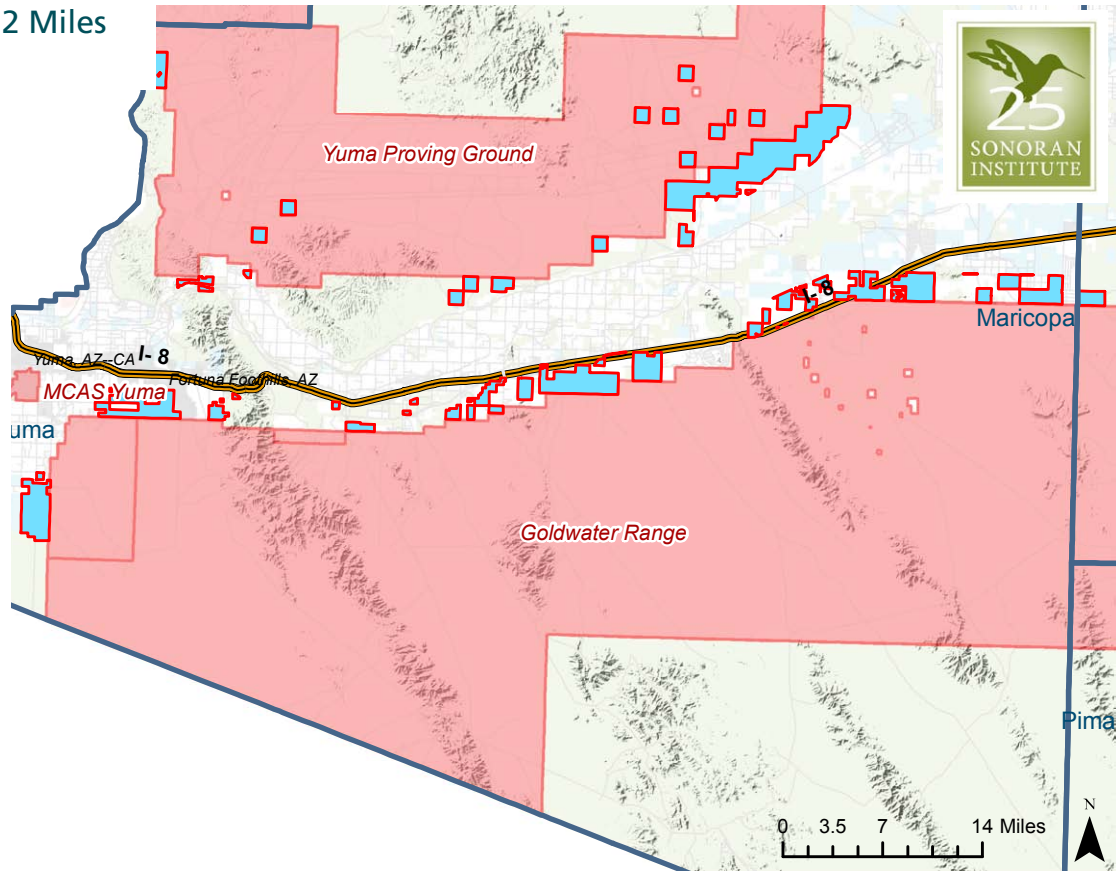
State Lands Within 2 Miles of BMGR West

- Counties
- Possible State Lands Encroachment
- Highways
- Military Facilities
- Roads
- Urban Areas

AZ Land Own Detail

Land Owner

- BLM
- Indian Res.
- Local or State Parks
- Military
- Other
- Private
- State Trust
- Wildlife



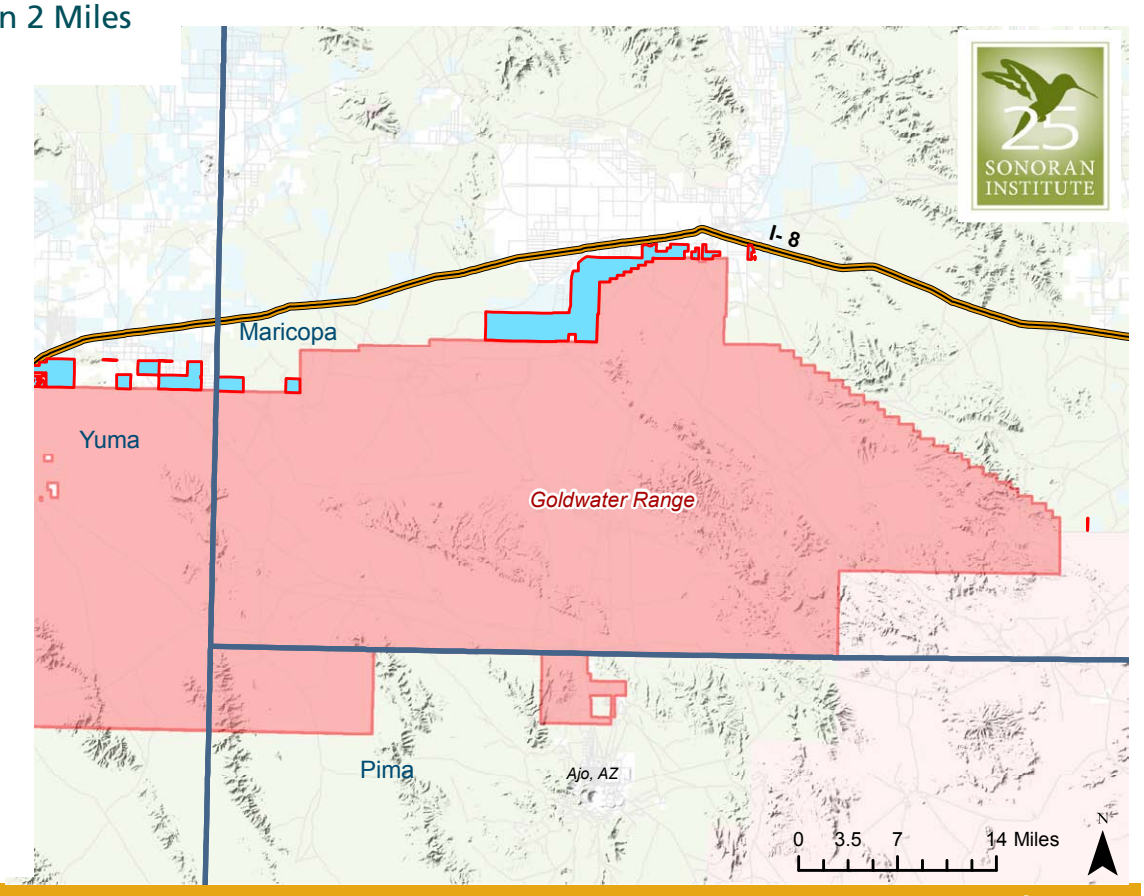
State Lands Within 2 Miles of BMGR East

- Counties
- Possible State Lands Encroachment
- Highways
- Military Facilities
- Roads
- Urban Areas

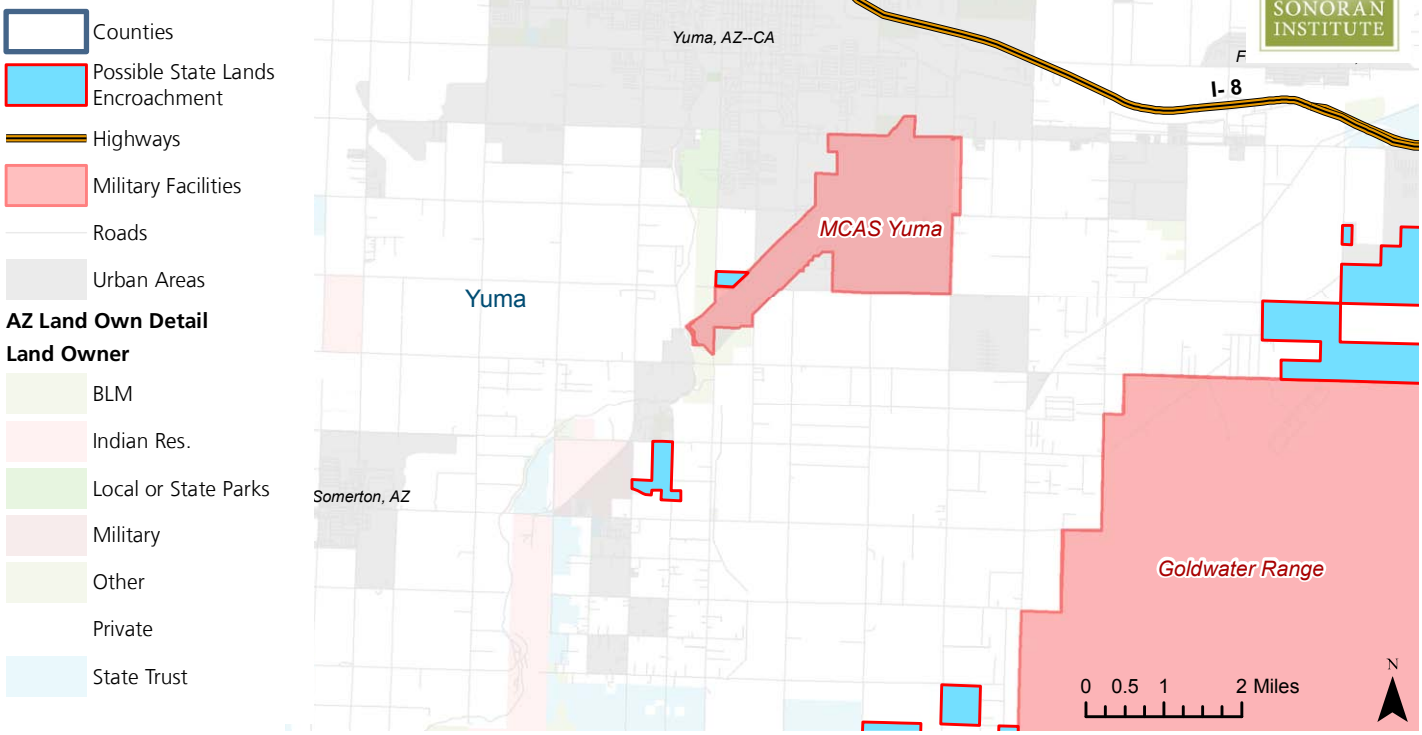
AZ Land Own Detail

Land Owner

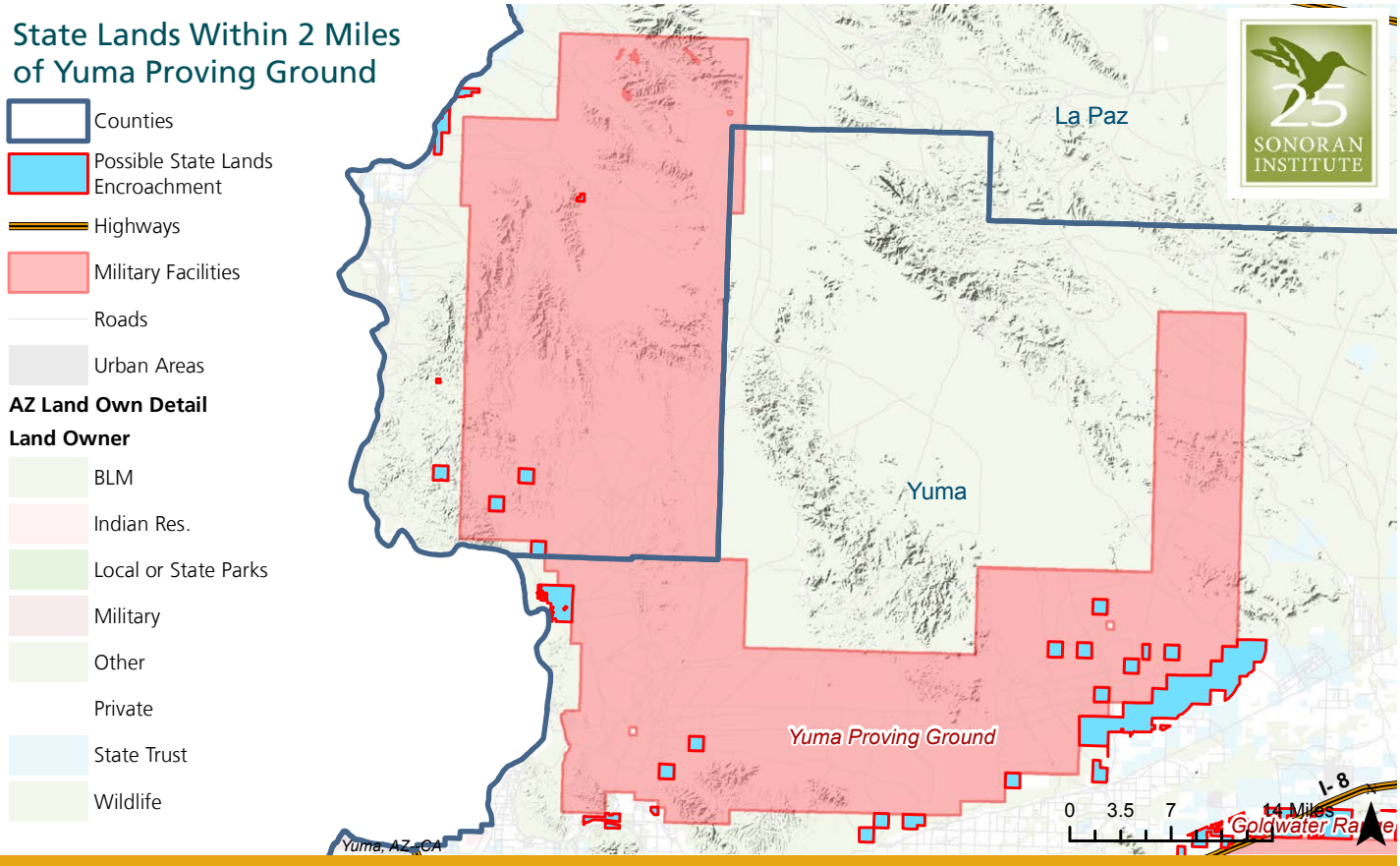
- BLM
- Indian Res.
- Military
- Natl. Parks
- Other
- Private
- State Trust
- Wildlife



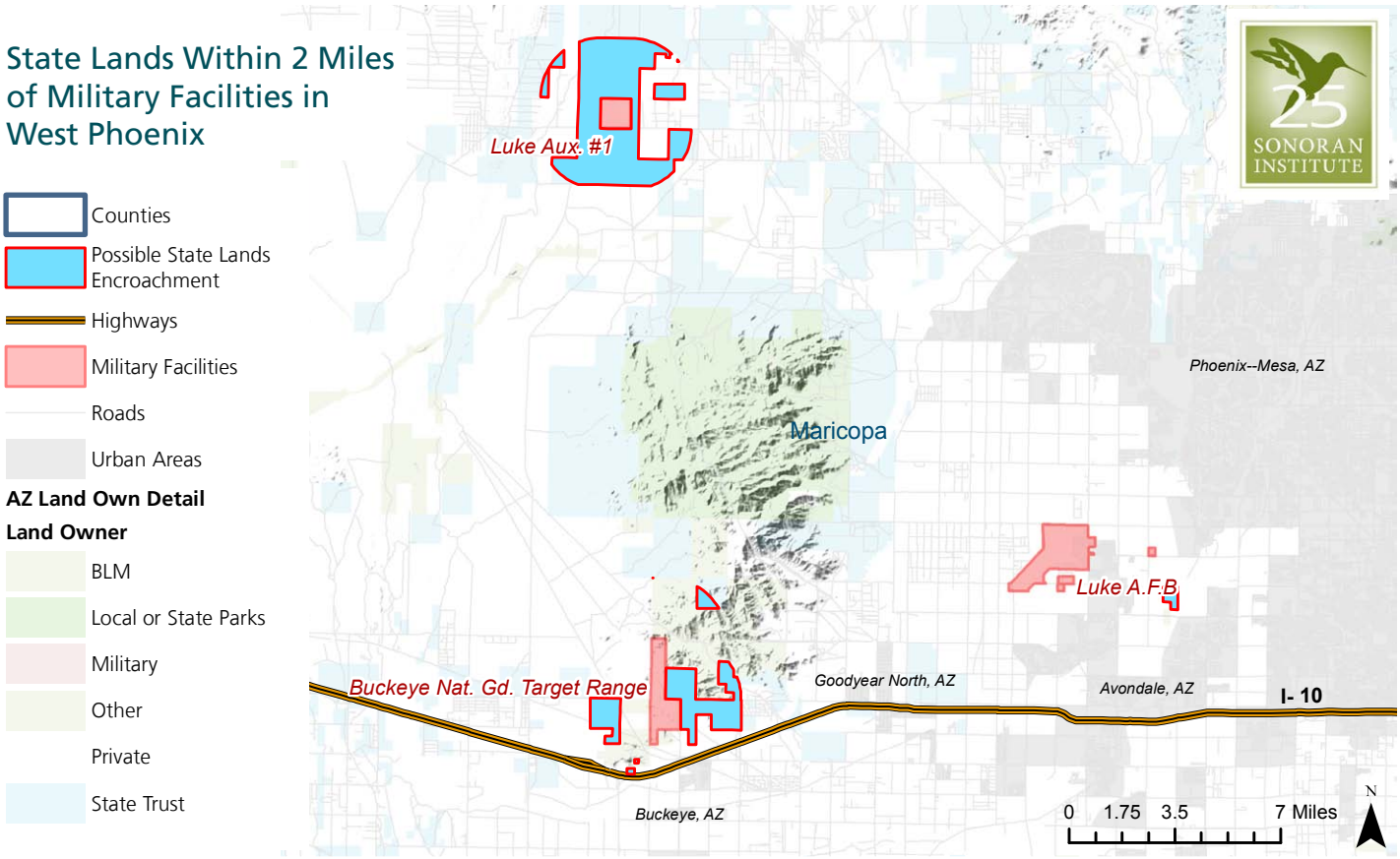
State Lands Within 2 Miles of MCAS Yuma



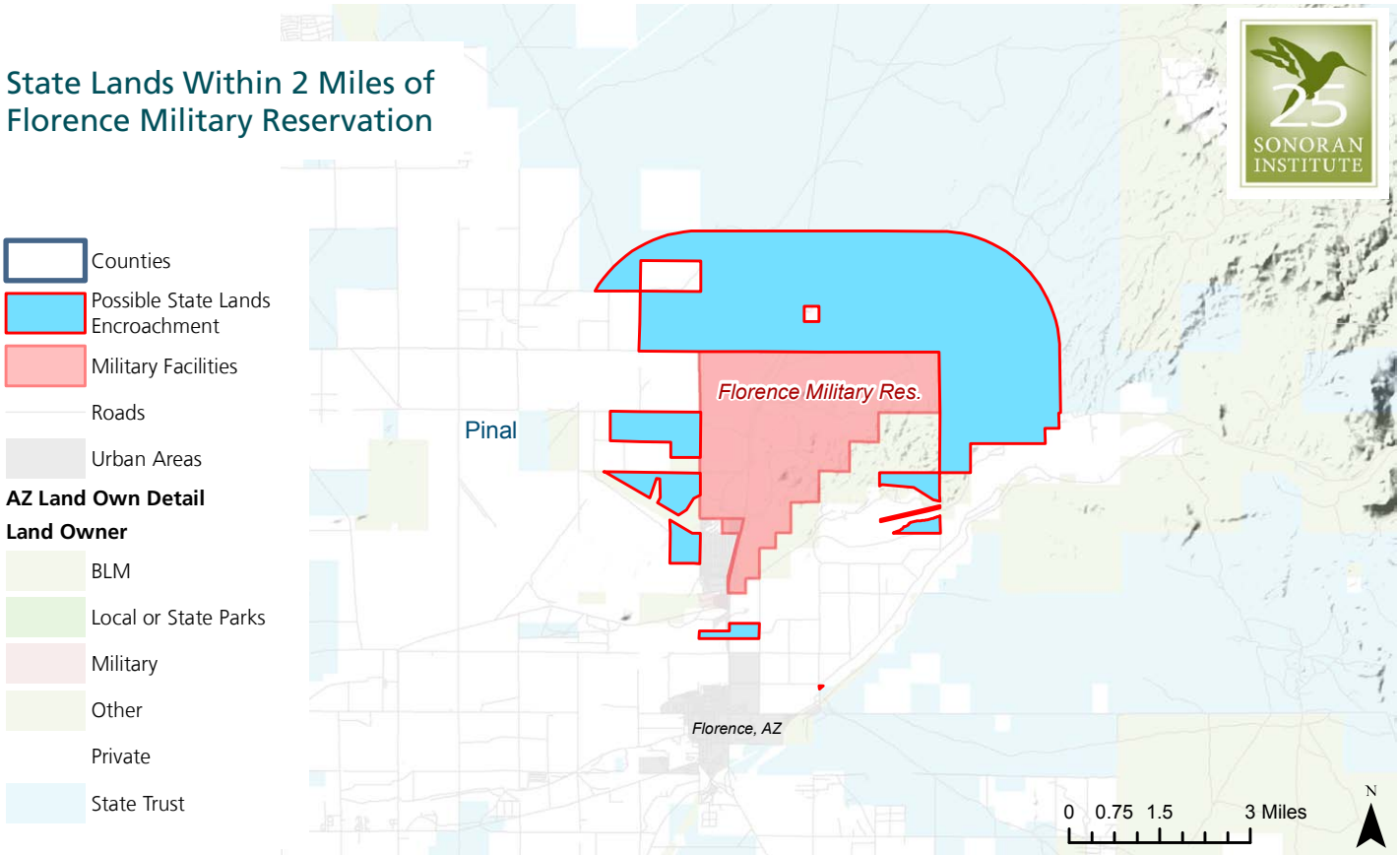
State Lands Within 2 Miles of Yuma Proving Ground



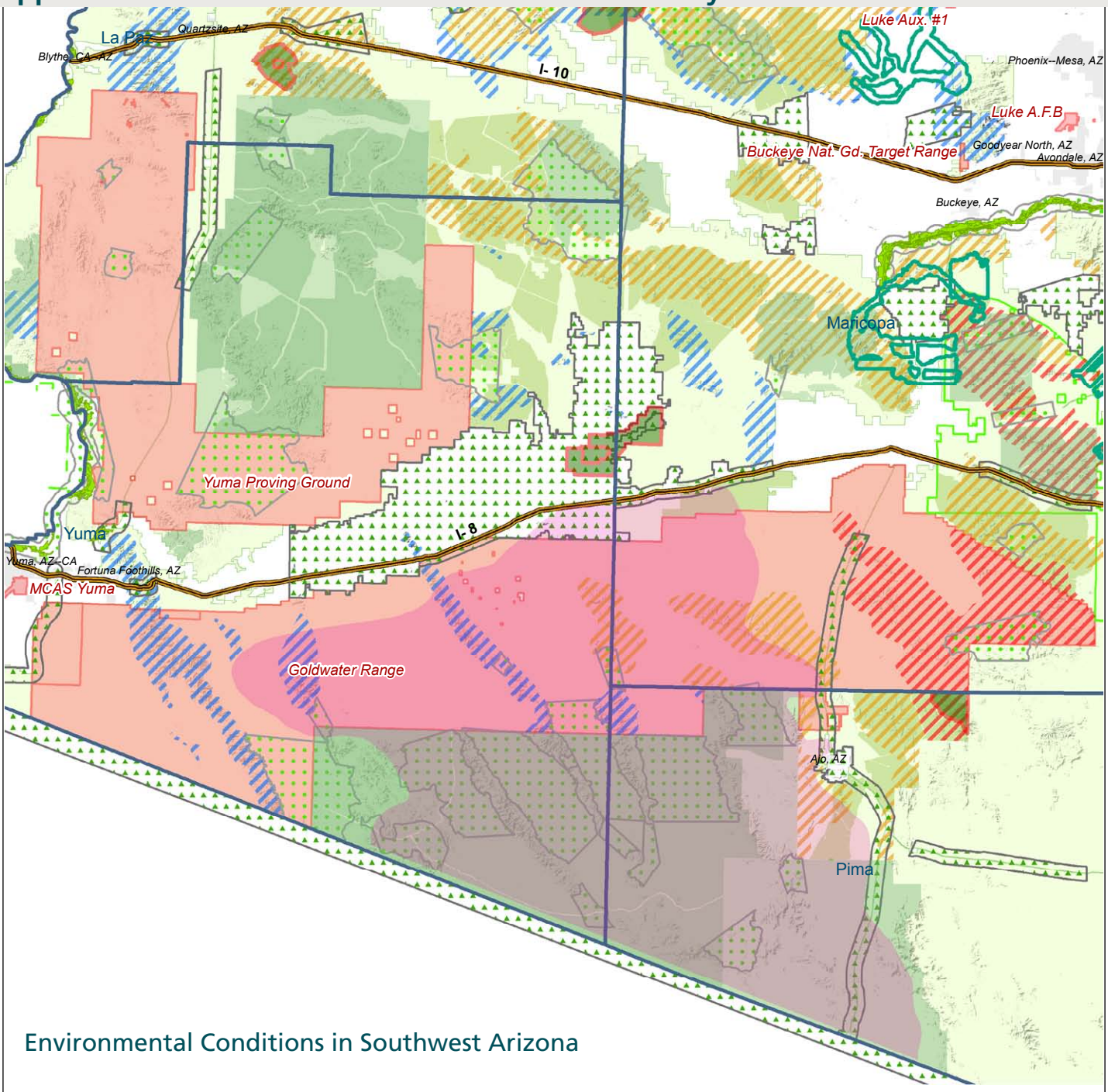
State Lands Within 2 Miles of Military Facilities in West Phoenix



State Lands Within 2 Miles of Florence Military Reservation



Appendix III - Environmental Conditions near Military Facilities



Environmental Conditions in Southwest Arizona

- Sonoran pronghorn
- AZGFD Missing Linkage
- Counties
- Highways
- US Fish and Wildlife
- Wilderness Area
- BLM ACEC
- Riparian Vegetation
- Potential Wildlife Linkage Zone
- Wildlife Linkage Across Habitat

Tortoise

- CAT1
- CAT2
- CAT3
- Citizen Inventoried Wilderness
- National Conservation Area
- National Monument
- Military Facilities
- Wildlife Habitat Block
- Urban Areas

0 4.5 9 18 Miles N

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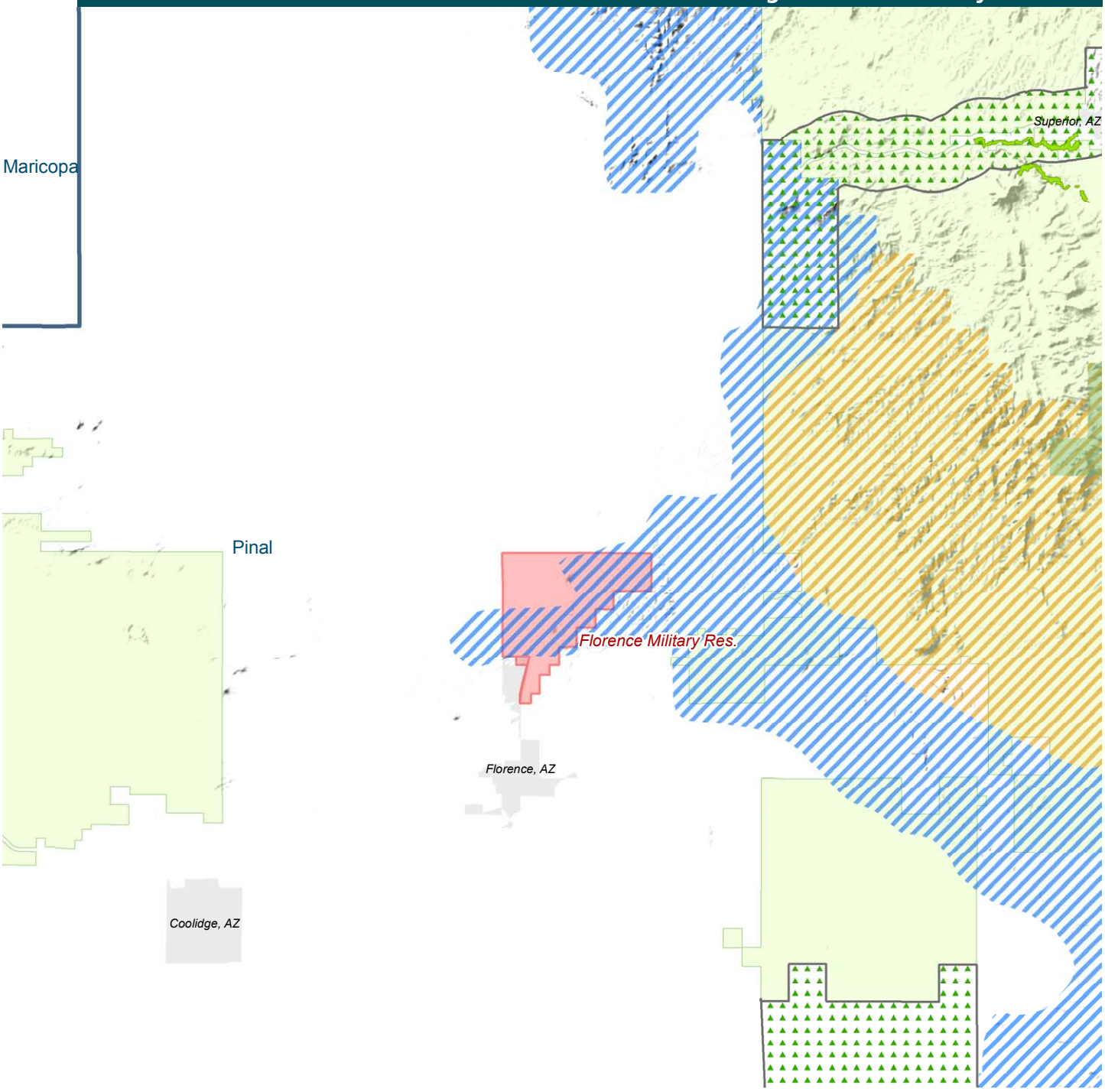


Environmental Conditions Near Florence Military Res.

- Counties
- Wilderness Area
- Riparian Vegetation
- Potential Wildlife Linkage Zone

Tortoise

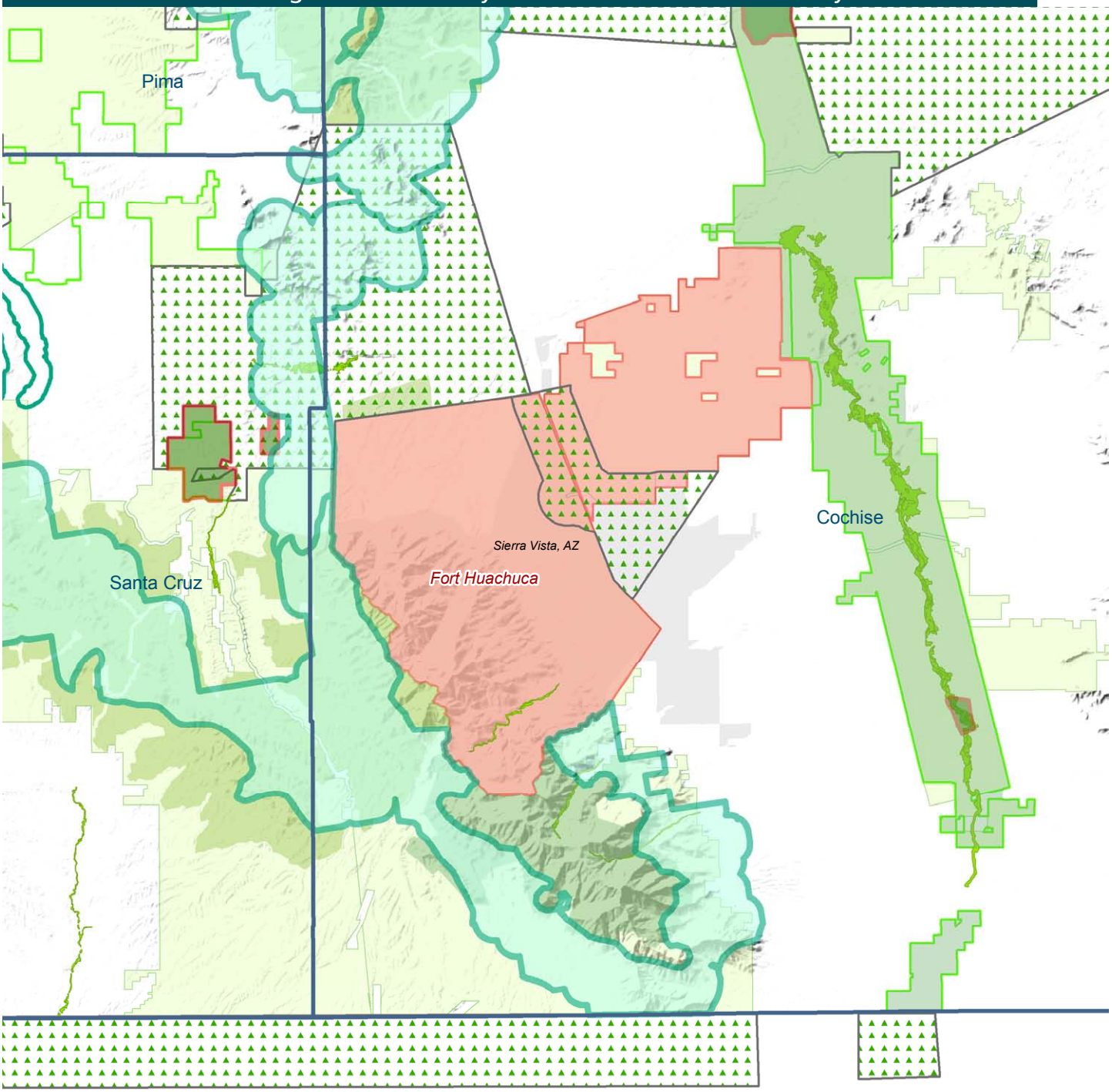
- CAT2
- CAT3
- Military Facilities
- Wildlife Habitat Block

- Urban Areas

0 1 2 4 Miles

N

25 SONORAN INSTITUTE



Environmental Conditions Near Fort Huachuca

- AZGFD Missing Linkage
- Counties
- Jaguar Critical Habitat
- Wilderness Area
- BLM ACEC (Area of Critical Environmental Concern)
- Riparian Vegetation
- Potential Wildlife Linkage Zone
- Citizen Inventoried Wilderness
- National Conservation Area
- Military Facilities
- Wildlife Habitat Block
- Urban Areas

0 1.25 2.5 5 Miles

N

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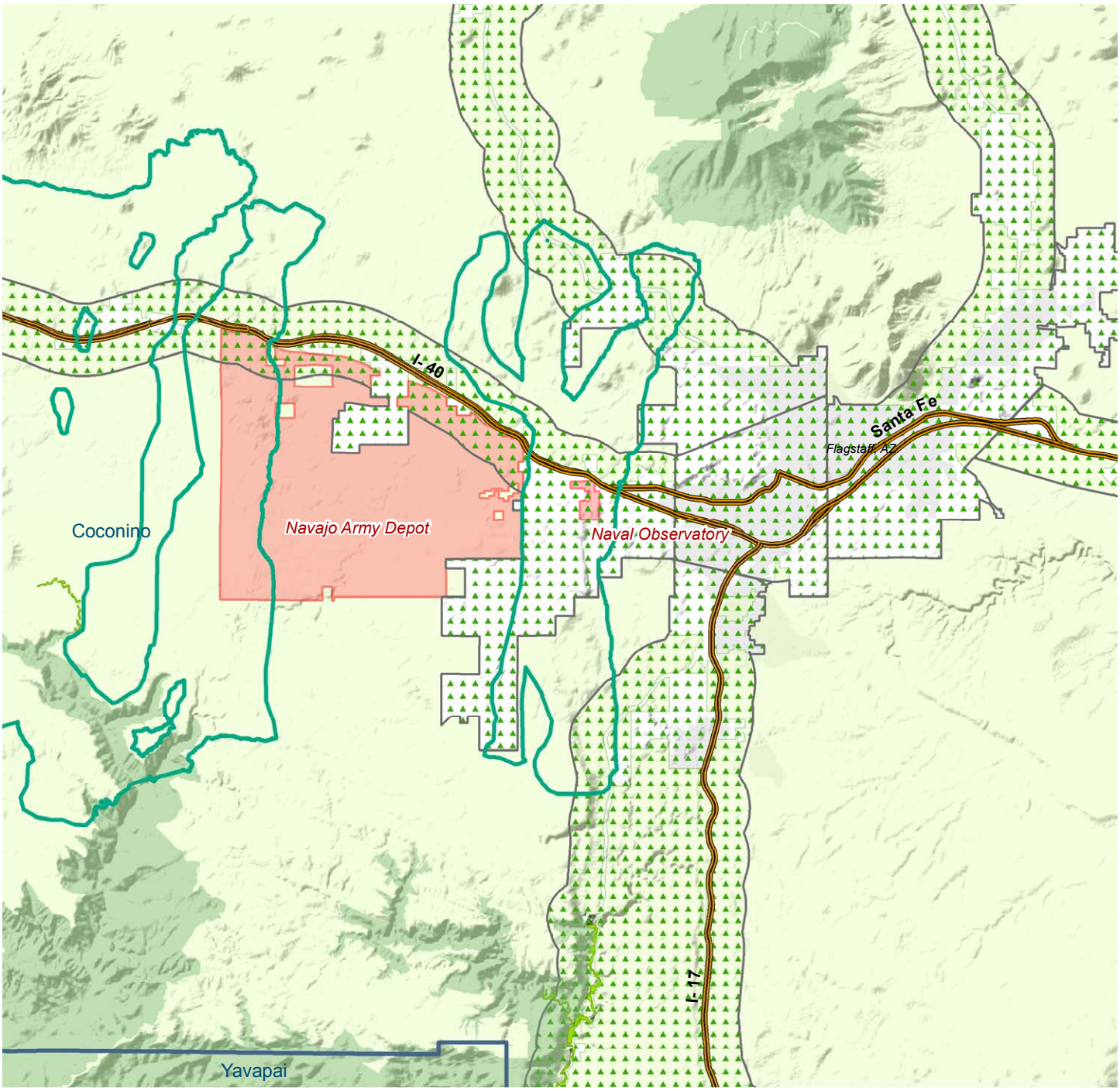


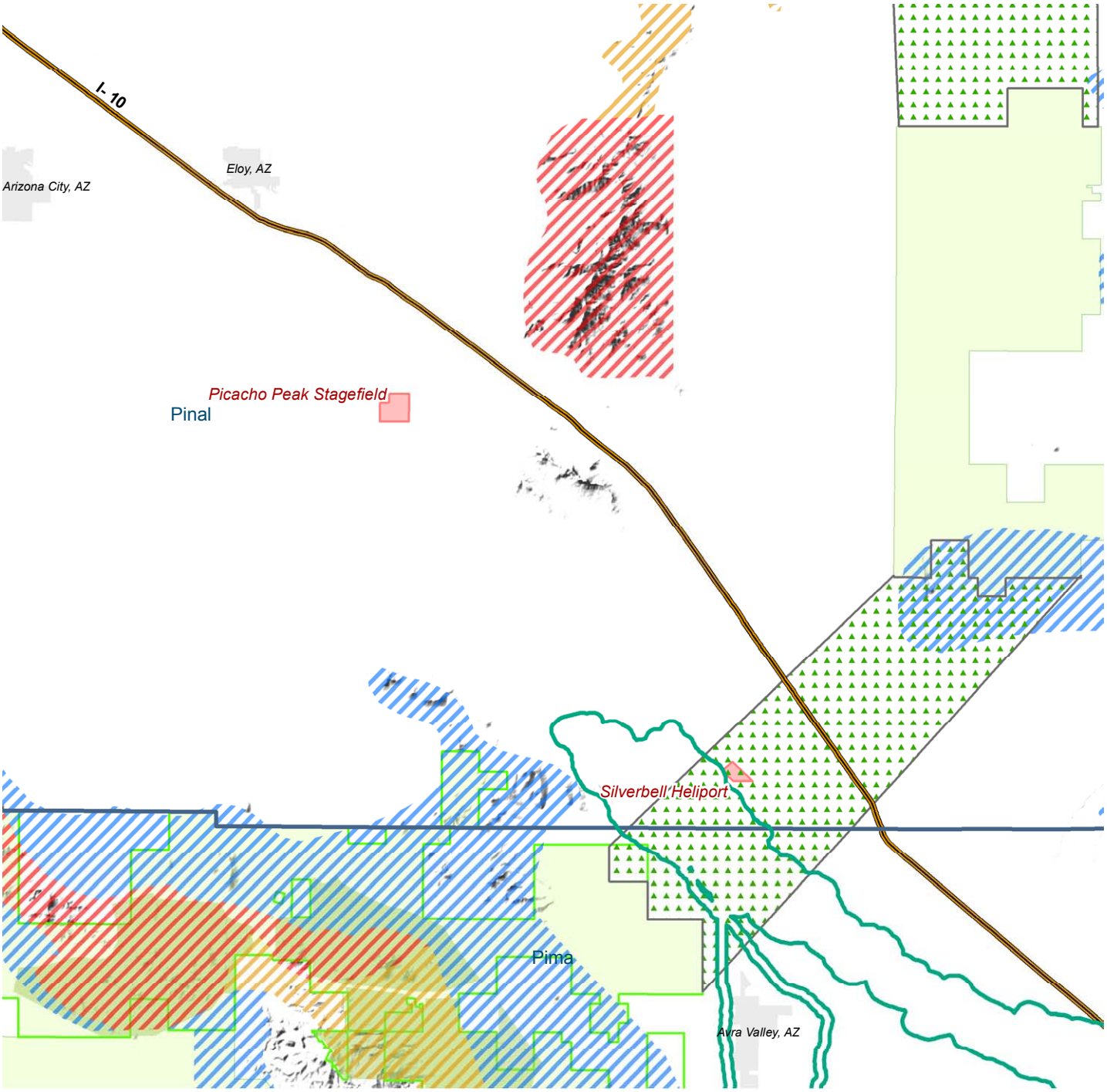
Environmental Conditions Near Flagstaff

- AZGFD Missing Linkage
- Counties
- Highways
- Wilderness Area
- Riparian Vegetation
- Potential Wildlife Linkage Zone
- Military Facilities
- Wildlife Habitat Block
- Urban Areas

0 1 2 4 Miles

N

SONORAN INSTITUTE 25



Environmental Conditions Near Picacho Peak

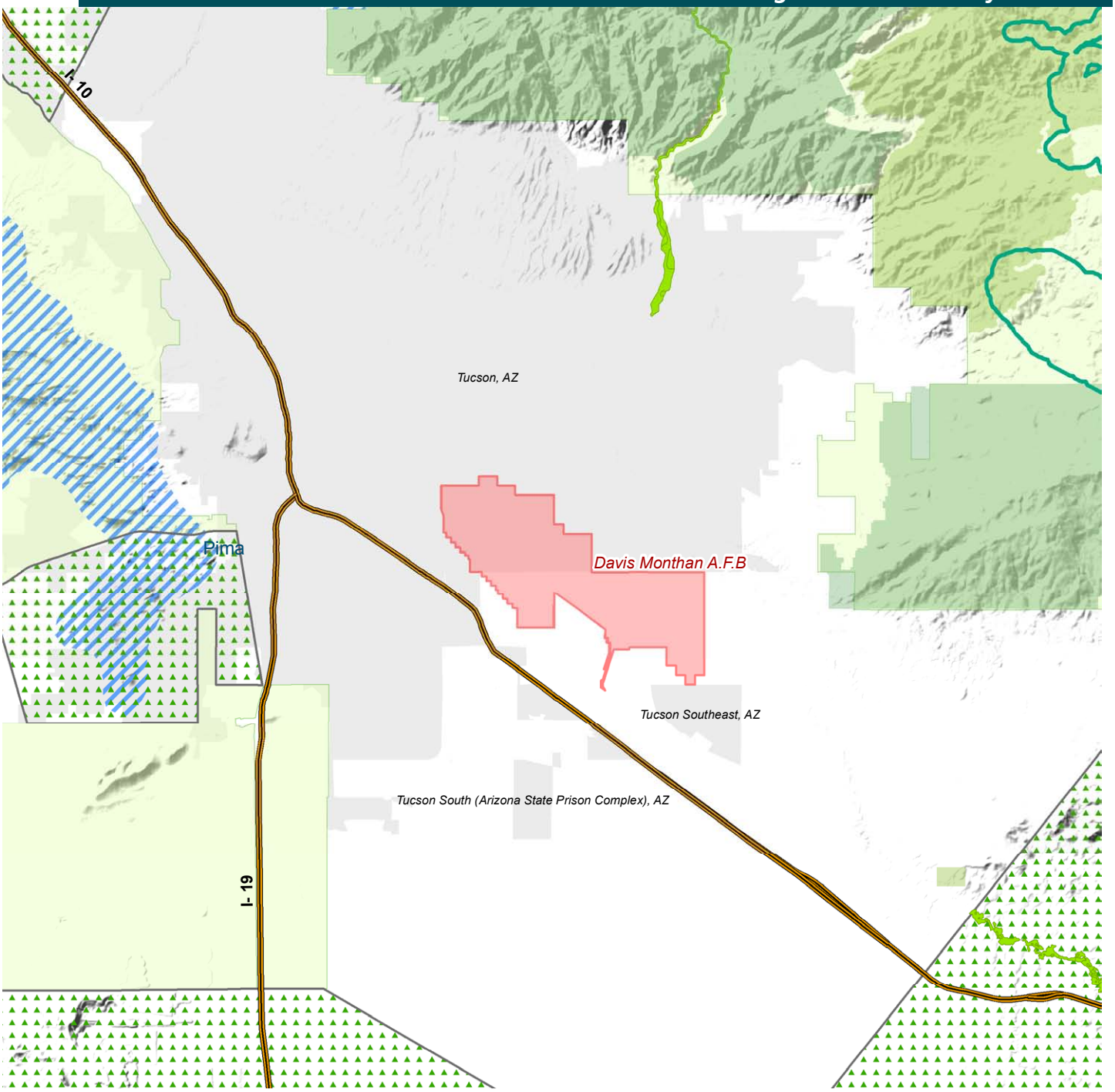
- AZGFD Missing Linkage
- Counties
- Highways
- Potential Wildlife Linkage Zone

Tortoise

- CAT1
- CAT2
- CAT3
- Citizen Inventoried Wilderness
- National Monument
- Military Facilities
- Wildlife Habitat Block
- Urban Areas

0 1 2 4 Miles N

SONORAN INSTITUTE 25



Environmental Conditions Near Davis-Monthan AFB

- AZGFD Missing Linkage
- Counties
- Highways
- Wilderness Area
- Riparian Vegetation
- Potential Wildlife Linkage Zone

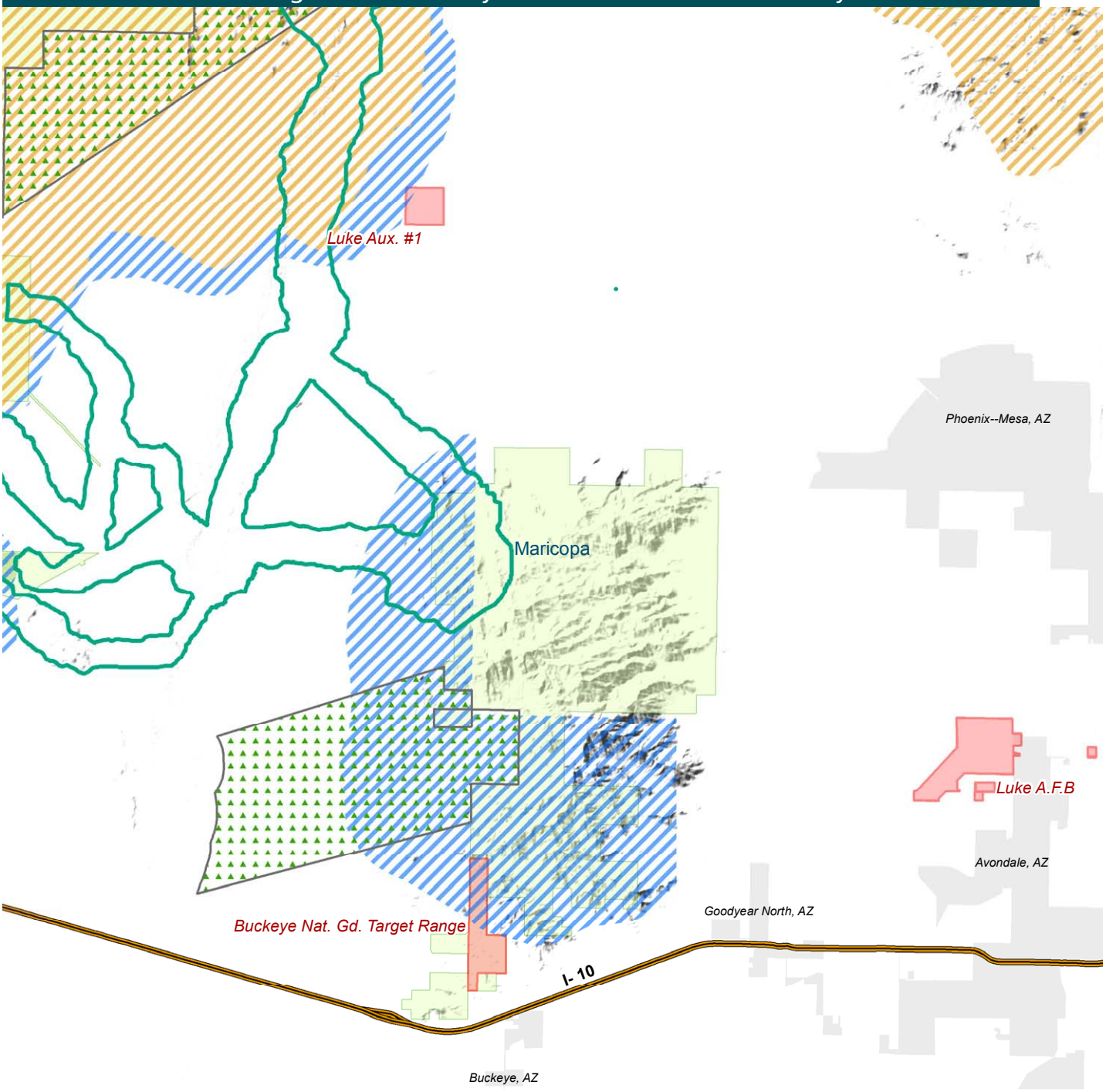
Tortoise

- CAT3
- Citizen Inventoried Wilderness
- Military Facilities
- Wildlife Habitat Block
- Urban Areas

0 1 2 4 Miles

N

SONORAN INSTITUTE



Environmental Conditions Near West Phoenix

- AZGFD Missing Linkage
- Counties
- Highways
- Potential Wildlife Linkage Zone

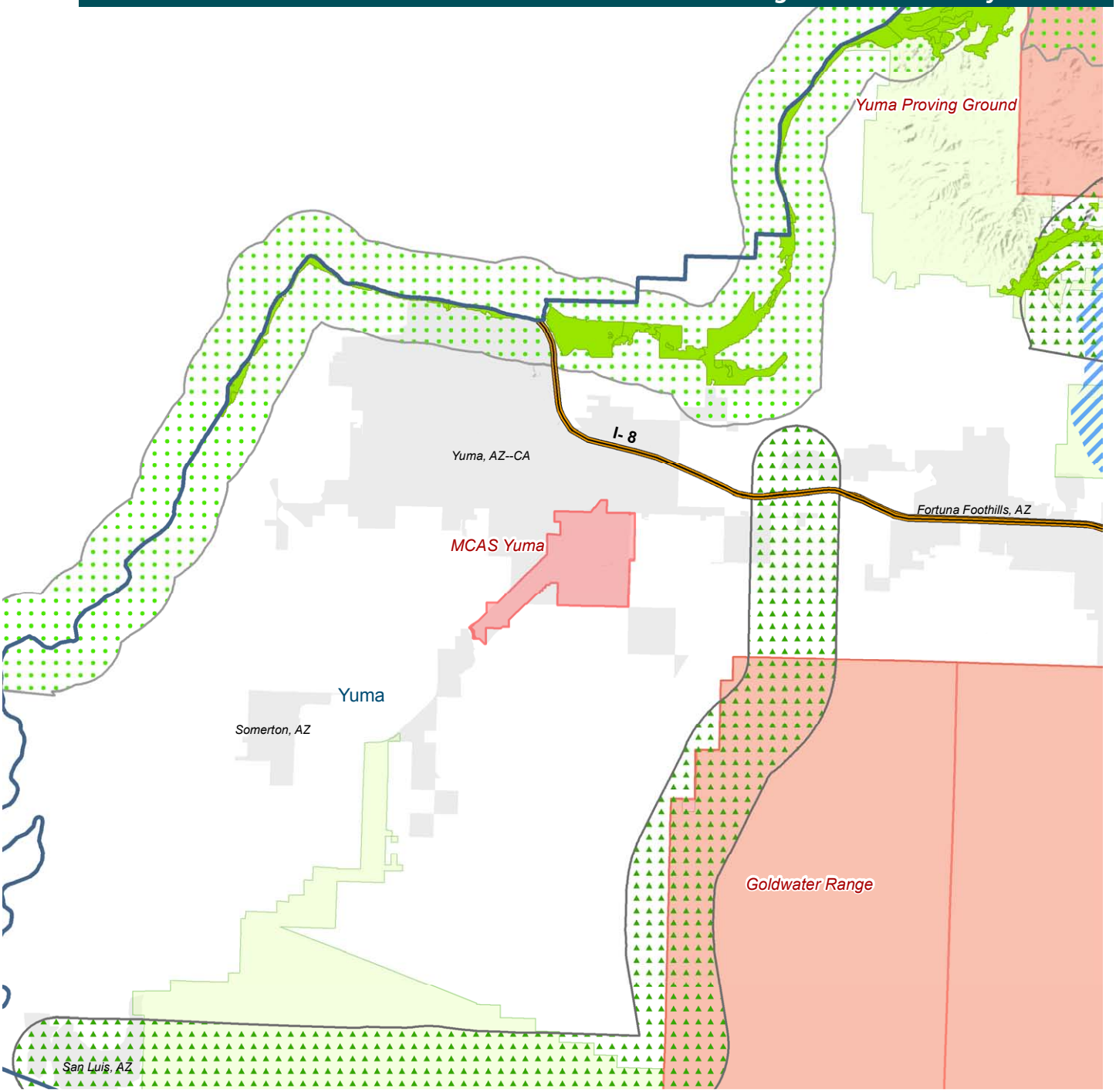
Tortoise

- CAT2
- CAT3
- Citizen Inventoried Wilderness
- Military Facilities
- Wildlife Habitat Block
- Urban Areas

0 1 2 4 Miles

N

SONORAN INSTITUTE 25



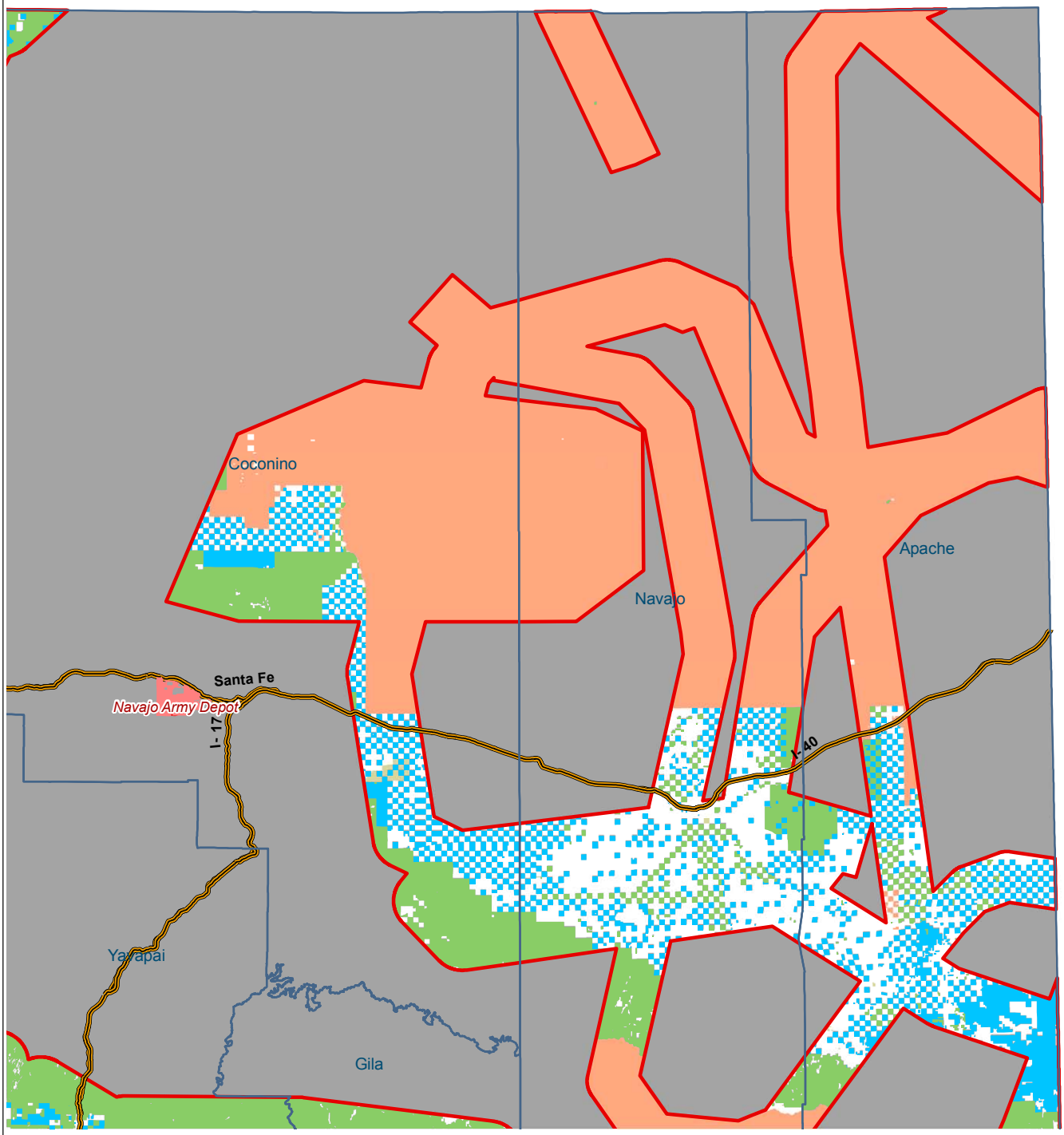
Environmental Conditions Near MCAS Yuma

- Counties
- Highways
- Riparian Vegetation
- Potential Wildlife Linkage Zone
- Wildlife Linkage Across Habitat
- **Tortoise**
- CAT3
- Military Facilities
- Wildlife Habitat Block
- Urban Areas

0 0.75 1.5 3 Miles

N

Appendix IV - Military Special Use Airspace in Arizona



Military Special Use Airspace (SUA) in Northeast Arizona

0 5 10 20 Miles

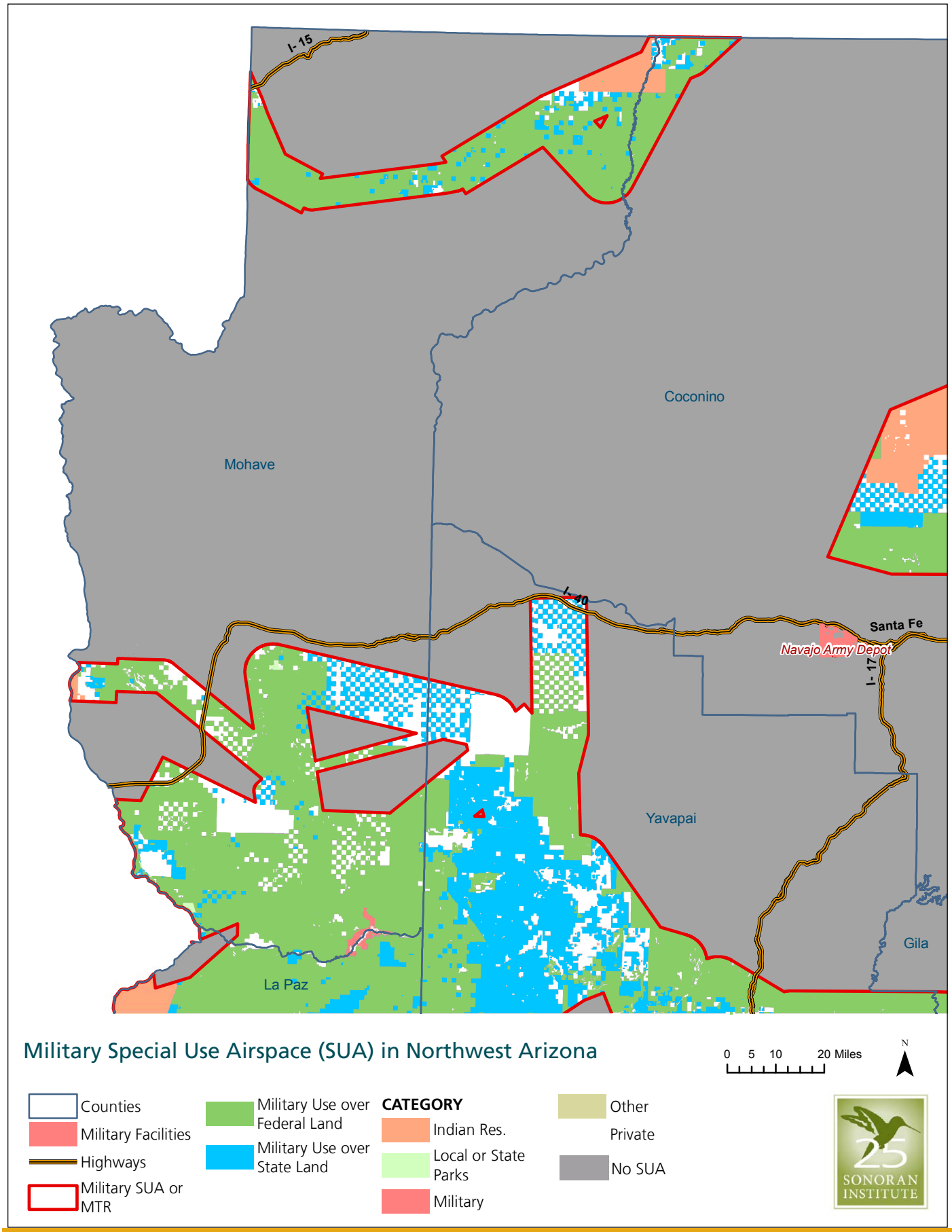
N

Counties
Military Facilities
Highways
Military SUA or MTR

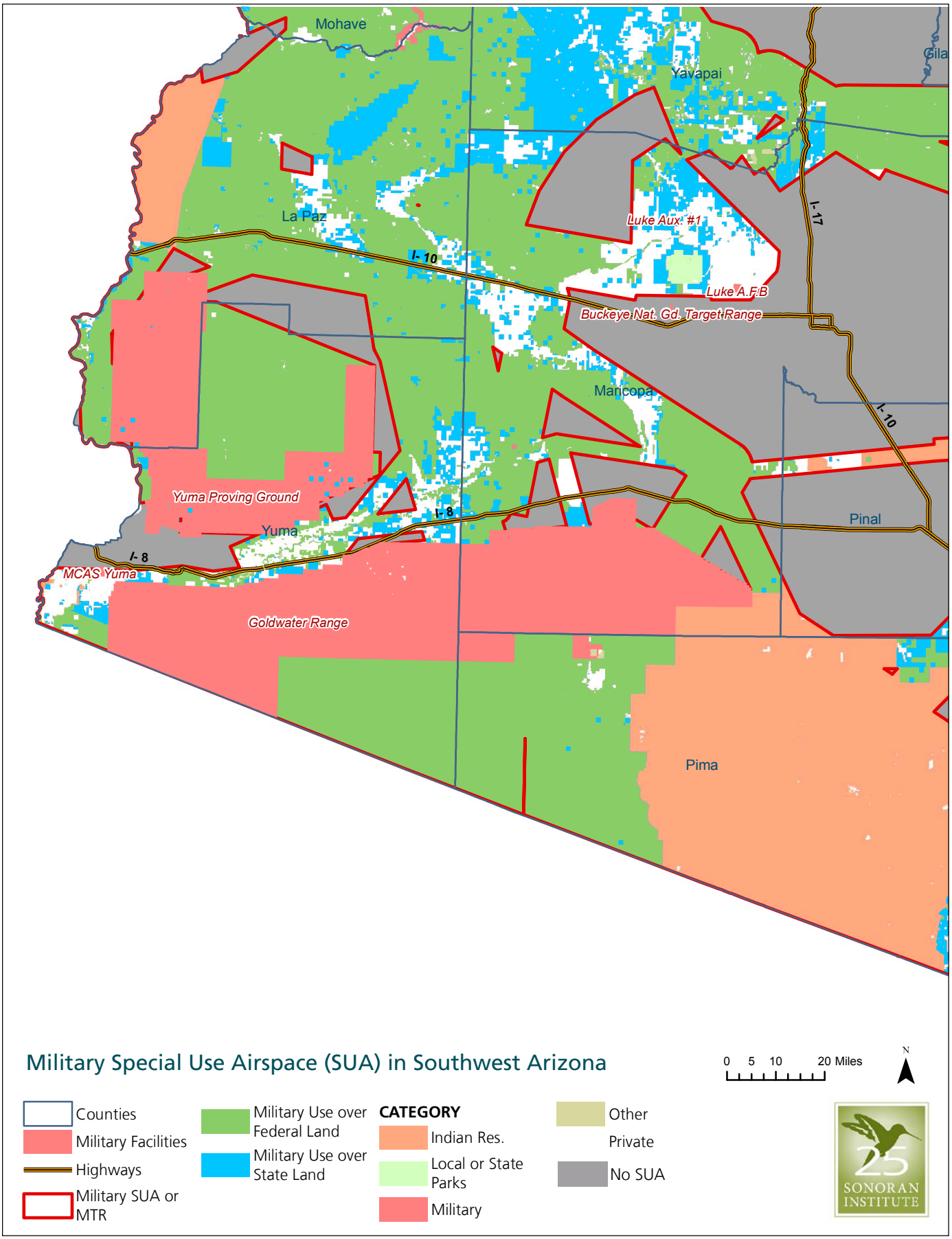
Military Use over Federal Land
Military Use over State Land

CATEGORY
Indian Res.
Local or State Parks
Military

Other Private
No SUA



Military Special Use Airspace (SUA) in Northwest Arizona



Military Special Use Airspace (SUA) in Southwest Arizona

0 5 10 20 Miles

N

- Counties
- Military Facilities
- Highways
- Military SUA or MTR
- Military Use over Federal Land
- Military Use over State Land

CATEGORY

- Indian Res.
- Local or State Parks
- Military
- Other Private
- No SUA

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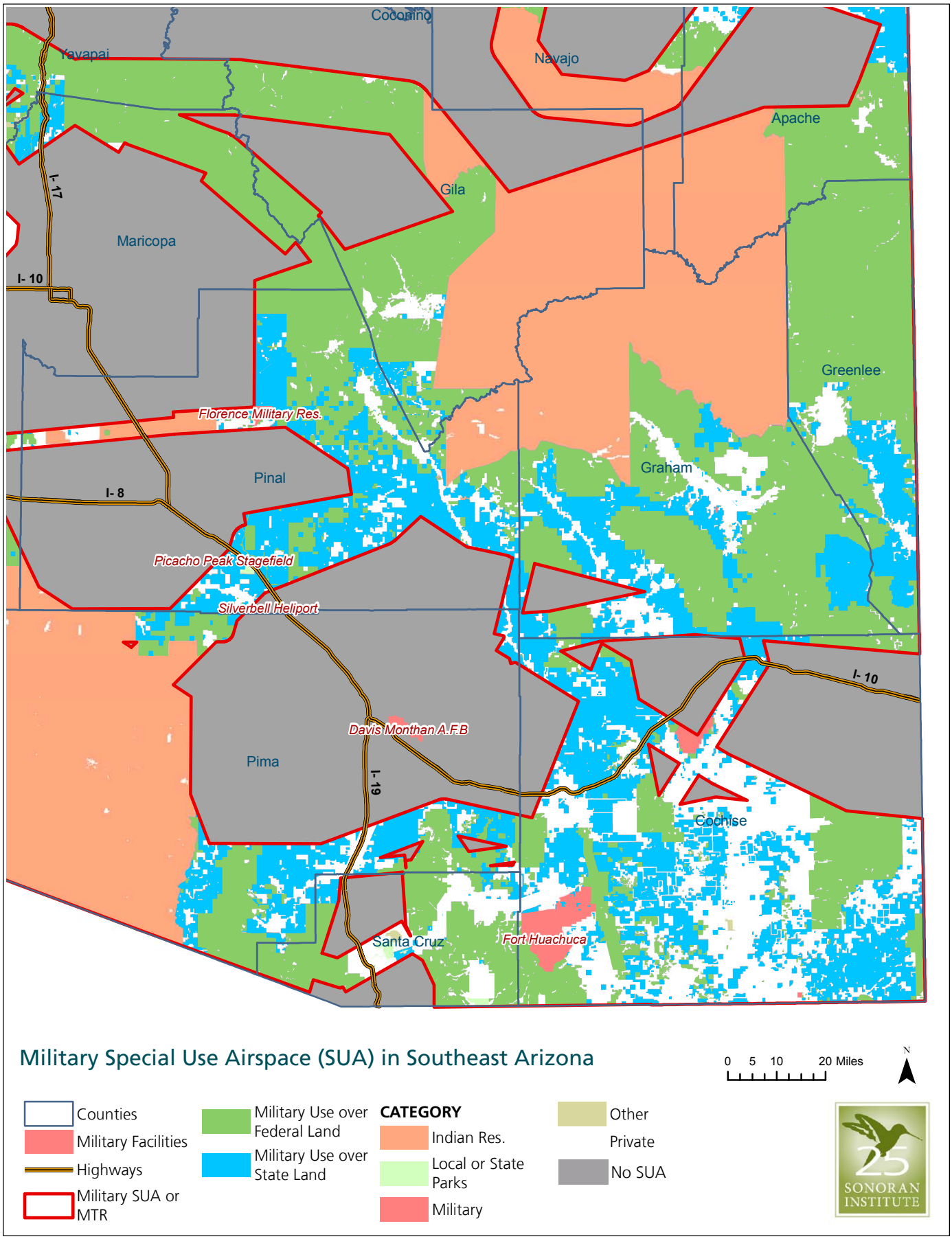
Coconino
Yavapai
Navajo
Apache
Gila
Maricopa
I- 17
I- 10
Greenlee
Florence Military Res.
Graham
Pinal
I- 8
Picacho Peak Stagefield
Silverbell Heliport
I- 10
Davis Monthan A.F.B
Pima
I- 19
Cochise
Santa Cruz
Fort Huachuca
Military Special Use Airspace (SUA) in Southeast Arizona
0 5 10 20 Miles
N
Counties
Military Facilities
Highways
Military SUA or MTR
Military Use over Federal Land
Military Use over State Land
CATEGORY
Indian Res.
Local or State Parks
Military
Other
Private
No SUA
25 SONORAN INSTITUTE

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Sonoran Institute and the U.S. Military

Sonoran Institute began collaborating with the United States military 15 years ago, assisting with natural resource management planning, urban growth modeling, socioeconomic research, and coordinated ecosystem monitoring across various military installations. This work stemmed from a Department of Defense Legacy Program effort from the late 1990s, which explored shared conservation responsibilities for the 55 million-acre Sonoran Desert Ecoregion.

Over time, Sonoran Institute's engagement has evolved from providing facilitation and research support for specific military planning processes to collaboration around big-picture solutions to the ever-evolving threats to military bases and their missions. These issues often stem from encroaching development pressures, be they housing developments, water drawdown, or electromagnetic interference. A short timeline of Sonoran Institute's involvement follows:

2000, An Ecological Analysis of Conservation Priorities in the Sonoran Desert Ecoregion:

This comprehensive conservation blueprint includes information on 2.3 million acres of U.S. Department of Defense lands. (The Nature Conservancy, Sonoran Institute, and Instituto del Medio Ambiente y el Desarrollo Sustentable del Estado de Sonora). http://azconservation.org/downloads/category/ecoregional_assessment

2002, Sonoran Desert Invasive Species Council Formation:

Sonoran Institute and The Nature Conservancy facilitated the formation of this Invasive Species Council, which collaborated with the Borderlands Cooperative Weed Management Area and the King of Arizona Cooperative Weed Management Area to develop a strategic plan for 7 million acres of the Sonoran Desert. (Sonoran Institute, the Nature Conservancy).

2003, Yuma Proving Ground Integrated Natural Resource Management Plan Update:

Sonoran Institute facilitated public involvement and opportunities for coordinated management with adjoining agencies. (Yuma Proving Ground and Sonoran Institute). www.yuma.army.mil/portals/0/docs/doc4.pdf

2003, Growth Model for Bureau of Land Management's (BLM) Phoenix South Planning Area:

A population projection and growth model was provided, along with training on how to use the model, to help the BLM and Luke Air Force Base manage encroachment issues. (Sonoran Institute, BLM, and National Aeronautic Space Administration-Blueline Consulting).

2005, A Biodiversity Management Framework for the Sonoran Desert National Monument:

This document describes a biodiversity management framework for the functional landscape that includes Sonoran Desert National Monument and the eastern portion of the Barry M. Goldwater Range. (The Nature Conservancy and Sonoran Institute). http://azconservation.org.

2008-2012, Morongo Basin Conservation Priorities Setting Project and Morongo Basin Conservation Priorities Report:

Sonoran Institute teamed up with diverse partners to identify community priorities for the 1,400 square mile-Morongo Basin, in the Mojave Desert. One of the highest priorities was protection of the Marine Corps Air Ground Combat Center near Joshua Tree National Park. (Sonoran Institute and Morongo Basin Open Space Group).

2008 – Present, Sonoran Desert Heritage Conservation Plan:

With the goal of promoting a landscape-scale conservation plan, the Sonoran Institute, along with a range of local, state, and national partners developed a plan for conserving almost a million acres of BLM lands that are directly in the path of urban growth in the West Valley of Phoenix. This effort was intended to model a collaborative and inclusive approach to conservation planning that would protect lands from urban encroachment and extenuating impacts while ensuring appropriate habitat connectivity to the Barry M. Goldwater Bombing Range.

2013, Protecting Arizona's $9 Billion Military Economy; Western Maricopa Military Land Use Nexus:

This report was released in March, 2013 to raise awareness around the need for proactive federal land conservation strategies to protect Arizona's military installations. The Sonoran Desert Heritage Conservation Plan was featured in the report.

2012-present, Cochise County Conservation Strategies:

Currently the Sonoran Institute is developing a strategy that will bring the diverse community in Cochise County together around a conservation plan that will protect the heritage of the region while promoting the continued viability of Fort Huachuca.

2012-present, Proposition 119, State Trust Land Exchange Ballot Measure:

In 2012, the voters of Arizona were presented with a ballot measure that sought to reform the state trust land system by allowing limited exchanges that meet a narrow set of criteria and that proceed through a defined process. The Sonoran Institute supported the measure and provided additional value by identifying state lands that could be candidates for exchange through this process. It is expected that exchanges under this authority will benefit Arizona's military facilities by creating buffers and protecting mission-critical lands.

Protecting Arizona's Military Mission

Mutual Benefit: Preserving Arizona's Military Mission and the Value of Publicly-Owned Lands

Front (top) and back cover photos courtesy Luke AFB.

This report recognizes the value of Arizona's open and unencumbered landscape and how it contributes to the preservation of a $9 billion segment of the state's economy. By understanding the range of encroachment pressures that could occur on publicly-owned lands throughout the state and implementing appropriate measures to resolve these issues, Arizona's military training and readiness activities can endure.

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