Altar Valley Fire Management Plan 2007

EXECUTIVE SUMMARY

Fire played an important role in the Altar Valley's ecology prior to Euro-American settlement. According to Bahre (1985), fires were "fairly frequent" in southern Arizona grasslands prior to 1882 and much larger in aerial extent within the grasslands. The cessation of major grassland fire preceded the brush invasion of the 1890s. Kaib (1998) further suggests that desert grasslands in this area likely burned once every 8–12 years. Those fire regimes likely played a crucial role in maintaining the area's grasslands by suppressing woody species and encouraging new growth (Sayre 2000, 2002). However, fire incidence in the Altar Valley decreased dramatically during most of the twentieth century. This is a result of several factors including: discontinuation of managed range fires with the introduction of wood fencing in the 1910s and 1920s, lack of sufficient herbaceous cover to sustain fires, increasingly effective and thorough fire suppression policies, and Endangered Species Act (Act) considerations.

In recent years, the steady increase of woody species and decrease of herbaceous species in the Altar Valley has resulted in a renewed interest in restoring fire to the ecosystem—both in its natural form and as a management tool.

A consortium of cooperating agencies and organizations is proposing the Altar Valley Fire Management Plan (AVFMP) to allow for the re-introduction of fire as a functioning component of the ecosystem within the planning area. The consortium includes the Altar Valley Conservation Alliance (AVCA), Natural Resource Conservation Service (NRCS), U.S. Fish and Wildlife Service (Ecological Services (AESO) and Buenos Aires National Wildlife Refuge (BAWNR)), Arizona Game and Fish Department (AGFD), Arizona State Land Department – Division of Forestry (ASLD), Pima County Natural Resources, Parks and Recreation Division, and The Nature Conservancy (TNC). The plan addresses Act compliance/recovery goals, while implementing a fire management plan that reestablishes fire as a component of the grassland ecosystem in the planning area.

1.0 Introduction and Background

1.1. The Altar Valley is an area approximately 52 miles long and 20 miles wide through which the Altar Wash flows out of the Arivaca watershed (Figure 1). The southern third of the wash and its tributaries are within the Buenos Aires National Wildlife Refuge (BANWR), which has its own fire management plan.

The planning area covers approximately 609,900 acres of land within the area generally bounded on the south by the U.S./Mexico border, on the north by State Route (SR) 86, on the west by the Baboquivari and Coyote Mountains, and on the east by the Sierrita, Las Guijas, Cerro Colorado, and San Luis Mountains. The planning area also encompasses three small towns: Three Points at the SR 86/SR 286 intersection, Arivaca at the extreme southeastern end of the Valley, and Sasabe at the southern end of the Valley (Figure 2). In addition, residential development associated with Tucson, a major metropolitan area

located just 20 miles to the northeast, has begun to encroach on the northern end of the valley.

Elevation ranges from 2,500 feet above mean sea level (msl) on the valley floor near SR 86 to 7,730 feet above msl at the top of Baboquivari Peak. Elevation increases relatively rapidly east to west from the valley floor to the tops of the surrounding mountains, and gradually from north to south on the valley floor.

The Altar Wash is the principal drainage feature that runs south to north through the center of the Altar Valley. The wash drains the entire 546,000-acre Altar Valley watershed, flows into Brawley Wash, which flows into the Santa Cruz River, northwest of downtown Tucson. The climate of the area is semiarid with relatively low precipitation, low humidity, and high summer temperatures. Precipitation averages 12 to 24 inches per year depending on elevation and falls primarily during two rainy periods—summer rainfall, which usually occurs in local convection showers, and winter rainfall, which is usually frontal and can occur over several days duration (Westland Resources 2000).

Geologically, the valley consists of four major zones: (1) mountains, in the upper reaches of the watershed; (2) pediments, which run from the base of the mountains to an average of 1 mile below the mountains; (3) alluvial fans or bajadas below the pediments; and (4) the central bottomlands or floodplain, which contains Altar Wash (Andrews 1937). The bajadas and central bottomlands consist of deep, unconsolidated material and generally represent the valley's richest soils.

This geologic makeup determines the hydrology. Rainfall runs quickly off the mountains surrounding the valley, across the pediments, and into the alluvia of the bajadas and bottomlands where it sinks into the groundwater. As a result, Altar Wash does not support perennial water, but flows only during heavy rain or flood events. Furthermore, perennial surface water within the watershed is extremely rare, occurring in various quantities only at Arivaca Creek, Arivaca Cienega, Brown Canyon, Thomas Canyon, San Luis Creek, and Sabino Creek. Groundwater, on the other hand, is abundant, and water levels in the deep wells across the valley have remained constant for as long as records have been kept (Sayre 2000).

Ranching families living and working in the Altar Valley formed the AVCA in 1995 and incorporated the organization as a 501(c)3 in 2000. The AVCA's mission is to conserve the Altar Valley for future generations, and its work is structured around the following program areas: resource stewardship, policy and planning, land protection, and community education. Membership in the AVCA is voluntary. Members currently include valley landowners; cooperating agencies and organizations; and concerned citizens from the Tucson area, as well as across the country. Approximately 43 percent of private lands, 77 percent of federal lands, and 70 percent of State Trust land in the planning area are within AVCA-member ranches.

1.2. Land Ownership

Primary land ownership in the Altar Valley is currently a mosaic of privately owned lands and lands owned and administered by Indian reservations, U.S. Department of Agriculture, U.S. Forest Service (FS), Department of Interior - Bureau of Land Management (BLM), Pima County, Arizona State Land Department, and Department of Interior - Fish Wildlife Service (FWS) (Figure 2). Nearly half the Altar Valley is State Trust Land. Therefore, the majority of the land within the Altar Valley planning area is still open space with minimal developments.

1.2.1. State Trust Lands

State lands within the Altar Valley were established in 1912 under the terms of the Arizona Enabling Act. At that time, the State of Arizona was granted ownership of four sections of land per township. Because many townships lacked unclaimed lands, the state was authorized to acquire in lieu sections elsewhere. As a result, much of the land in the Altar Valley planning area—at that time unclaimed— was taken into possession by the State. The State remains the largest landowner in the planning area, managing approximately 294,000 acres, or 48 percent of the planning area. These lands—called state trust lands—are administered by the ASLD. State trust lands are managed primarily to produce revenue for the Arizona State Trust beneficiaries, including the state's school system. In the Altar Valley planning area, state trust lands are leased primarily for livestock grazing (Lehman 2003).

1.2.2. Private Lands

Private lands within the Altar Valley planning area are found primarily in two areas: 1) the margins of the mountain ranges surrounding the valley and 2) along the Altar Wash. This distribution is a reflection of the constraints of water availability at the time the Valley was first settled. The majority of these lands is undeveloped and consists of private ranches; however, a small but growing amount of land has been converted to residential and commercial uses.

Land uses in the planning area consist primarily of ranching and livestock grazing. Other land uses include mining, fuelwood cutting, hunting, and other recreational activities (e.g., hiking, off-road vehicle use). Each ranch is composed of privately owned lands in combination with state trust and/or public grazing leases on County, ASLD, BLM, or FS lands (Figure 2). Ranches in the planning area (Figure 3) vary in size from 10,000 to 70,000 acres and, in total, support approximately 5,100 cows. Those cows, in turn, produce about 3,800 calves and yearlings each year, which equates to nearly $2 million annually in gross livestock revenues (Westland Resources 2000). All developed ranch facilities—with the exception of some holding corrals, roads, fences, and water sources—occur within the private portions of the ranches. Individual livestock pastures, however, generally do not observe the boundaries between public and private lands but follow natural (i.e., ridgeline) or manmade (i.e., fenceline) features. The result is that private lands and governmental lands intersect within individual pastures and are indistinguishable from each other—at least with respect to livestock management. The

Altar Valley supports a total of 19 individual ranches, or a portion thereof, with all those currently participating as AVCA members. Private lands compose approximately 13 percent of the planning area.

1.2.3. Federal Lands

The primary block of Federal land in the Altar Valley consists of the 116,000-acre BANWR, which runs north to south in the south-central portion of the planning area and is administered by the FWS. Formerly a private ranch, the BANWR was established to support the reintroduction of the masked bobwhite quail. Management goals of the BANWR are outlined in the BANWR *Comprehensive Conservation Plan* (USFWS 2002). Livestock grazing has been excluded from the area since its conversion to a wildlife refuge.

In addition to the BANWR, the BLM and the FS administer small portions of land within the Altar Valley. BLM lands include approximately 24,000 acres, or 3.9 percent of the planning area, and include 16 livestock-grazing allotments managed in association with private and state land-grazing operations. These operations are scattered primarily around the margins of the planning area and make up only minor portions of most individual Altar Valley ranches. Similarly, only a small amount of FS land—about 85,000 acres, or 13.9 percent, located at the extreme southeastern tip of the valley—occurs within the planning area. However, some Altar Valley ranches (e.g., the Rancho Seco/Santa Lucia, Chilton-Arivaca, and Sierrita ranches) include large FS or BLM grazing leases.

1.2.4. Tribal Lands

Tribal lands are within the Schuk Tauk District of the Tohono O'Odham Nation. These lands are totally private and may be used only by tribal members.

1.2.5. Pima County Lands

In 2001, the Pima County Board of Supervisors adopted the Sonoran Desert Conservation Plan (SDCP). The comprehensive regional planning effort combines short-term actions, which protect and enhance the natural and cultural environment with long-range planning to ensure that the conserved and urban environments not only co-exist, but develop an interdependent relationship- where one enhances the other. In 2004, the County began implementation of a $ 174 million bond program to acquire biologically sensitive and important community open space lands across the County, as identified within the SDCP. A number of large parcels of land in the Altar Valley planning area have been acquired under the bond program. To date the County has acquired title to almost 13,000 acres in the Altar Valley planning area and has over 32,000 acres in associated grazing leases on state and federal lands. Pima County Natural Resources, Parks and Recreation administers these lands. While conservation is the primary goal of the acquisitions, many of the parcels will also be maintained as working landscapes and previous uses like farming, ranching and dispersed recreation will continue under sustainable management strategies.

1.2.6. City of Tucson Lands

The City of Tucson controls much of the land immediately north and south of 86 along the Brawley Wash.

1.3. Assessment of Existing Vegetation

In 1999 and 2000, a survey of the Altar Valley's rangeland resources was conducted. This survey documented the condition of the valley's vegetative resources, mesquite (*Prosopis* spp.) densities, nonnative plant cover, and overall rangeland health (Meyer 2000). Survey procedures followed Natural Resources Conservation Service (NRCS) standards for natural resource inventories, which delineate Common Resource Areas/ Major Land Resource Areas (CRA/MLRA) based on physiographic features, soils, climate, and other factors (Figure 4). Additionally, The Nature Conservancy (TNC) conducted a recent review of grasslands within southern Arizona that depict current grassland condition types (Gori and Enquist 2003). Both sets of data were reviewed and combined into one vegetation data set for the Altar Valley planning area.

1.3.1. Vegetation Classification from Meyer 2000

1.3.1.1. Mexican Oak-Pine and Oak Savanna

This CRA/MLRA occurs on the upper slopes of the Baboquivari and Sierrita Mountains (above 4,300–5,000 feet above msl) and is clearly in the best overall habitat condition within the watershed. Similarity indexes for the ecological sites in this area are in the range of 80 percent; soils, biotic integrity, and watershed function are all rated stable, intact, and functioning, respectively. Mesquite canopies are light and there are few to no nonnative grasses. These conditions probably reflect the high-elevation location of this CRA/MLRA, which results in less grazing pressure, fewer vegetative impacts (e.g., mesquite encroachment), greater rainfall, and less erosion.

1.3.1.2. Sonoran Semidesert Grassland and Upper Sonoran Desert

The Sonoran Semidesert Grassland CRA/MLRA extends from the lower slopes of the mountains, across the bajadas and foothills, and into the Altar Valley (ranging in elevation between 3,200 and 5,000 feet). The upper Sonoran Desert CRA/MLRA occurs at elevations below 3,200 feet on the west side of the valley and below 3,400 feet on the east side. A number of ecological sites occur in both CRA/MLRA s, including loamy uplands, sandy loam uplands, sandy bottoms, and deep sandy bottoms. These ecological sites constitute the majority of the Altar Valley's rangelands. These sites also received the greatest historic grazing pressure and display the majority of the current ecological problems in the watershed.

Similarity indexes in these ecological sites range from a low of 29 percent to a high of 67 percent, which is primarily because of two factors: (1) the presence of mesquite where

grasslands once occurred and (2) the presence of nonnative grasses where native grasses once occurred. It is important to note, however, that mesquite encroachment is always undesirable while nonnative grasses, though not preferable, is often beneficial because it prevents erosion (Gould 1982; Martin and Morton 1993; Parizek, Rostagno, and Sottini 2002). The area of the watershed in the poorest overall condition is the valley's uplands—occurring midway between the valley floor and the mountains (i.e., the Sonoran Grassland CRA/MLRA). Rangeland health criteria for a number of the ecological sites in this area (e.g., loamy uplands, loamy bottoms, and sandy bottoms) are nearly all considered at-risk—the result of mesquite encroachment, loss of grassland cover, sheet erosion, and gully erosion in the washes. On the valley floor (i.e., the Upper Sonoran Desert CRA/MLRA), overall conditions are better, because enough annual vegetation grows here to hold the soil in place. The Altar Wash arroyo, however, is still one of the valley's most substantial ecological challenges.

The current ecological conditions in the Altar Valley watershed, as a whole, are better today than at any time in the past 75 years (Meyer 2000). The mountain areas are in near historic condition and many ecological sites in the Upper Sonoran Desert CRA/MLRA (e.g., shallow uplands, loamy uplands, deep sandy bottoms, loamy bottoms) and the Sonoran Semidesert Grassland CRA/MLRA (e.g., granitic hills, shallow uplands, loamy hills) are rated as stable, intact, and functioning. Furthermore, no ecological site evaluated during the survey rated as not stable, not intact, or not functioning.

1.3.2 Grassland Classification from Gori and Enquist 2003

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Gori and Enquist (2003) developed a series of six grassland classes or types using information from range management experts and the literature to define threshold values for shrub cover. These grassland classes have been reviewed and were considered in developing fire danger rating fuel models and fire behavior prediction models. The Gori and Enquist types include the following:

TYPE A—*Native grassland with low shrub cover*. Grassland with less than 10 percent shrub cover whose herbaceous component is entirely or predominantly native perennial grasses and herbs; nonnative perennial grasses are uncommon or absent.

TYPE B—*Shrub-invaded native grassland with restoration potential*. Grassland composed of native perennial grasses and herbs (nonnatives absent or uncommon) with 10–35 percent total shrub cover 3 and mesquite or juniper cover less than 15 percent. A key characteristic of this type is its restoration potential. Shrub cover can be reduced using prescribed burns, and the site can be restored to TYPE A grassland when sufficient fine fuels have accumulated for fire spread.

TYPE C—*Sacaton riparian grassland*. Grassland dominated by giant sacaton that occurs on floodplain terraces along drainages.

TYPE D—*Nonnative grassland with low shrub cover*. Grassland with less than 10 percent shrub cover where nonnative perennial grasses are common or dominant.

TYPE E—*Shrub-invaded nonnative grassland*. Grassland with 10–35 percent total shrub cover and mesquite or juniper cover less than 15 percent; nonnative perennial grasses are common or dominant. A defining characteristic for this type is its potential for shrub reduction using prescribed burns and for "restoration" to TYPE D grassland.

TYPE F—*Shrubland-former grassland*. Former grassland with greater than 15 percent canopy cover of mesquite and juniper combined or greater than 35 percent total shrub cover; perennial grass canopy cover usually less than 1 percent, always less than 3 percent; type conversion to shrubland that is either permanent or may require a longer time period or more livestock exclusion for partial recovery of perennial grasses.

1.4. Understanding the Outcomes of Prescribed Fire Use

"Fire is an essential ecological process in many fire dependent ecosystems. In large areas of the country, fire exclusion from these ecosystems has led to unhealthy forest, woodland and rangeland conditions. These areas are at risk of intense, severe wildfires that threaten communities and cause significant damage to key ecological components. As one component of fire management, prescribed fire is used to alter, maintain, or restore vegetative communities; achieve desired resource conditions; and to protect life, property, and values that would be degraded and/or destroyed by wildfire."(USDI/USDA 2006)

The exclusion of natural fire from the ecosystem is a main contributing factor to the changes in grassland composition. As a result, shrub encroachment has occurred on over 84 percent of existing and former grassland in the U.S. (Gori and Enquist 2003). On the Santa Rita Experimental Range (SRER) "the most conspicuous change is the increase of mesquite, which began before 1903 when the spread of seed by livestock and cessation of fire led to the establishment of mesquite in the open grasslands" (McClaran 2003). Over the past century woody plants have increased in abundance on sites formerly occupied by grasslands in the Sonoran Desert (Cox et al. 1993). The woody invasion of grassland by honey mesquite (*Prosopis glandulosa*), creosote bush (*Larrea tridentata*), and joint fir (*Ephedra* spp.) has also been noted in the Chihuahuan Desert (Desmond and Montoya 2006) and Ansley et al. (2001) note long-term increases in mesquite canopy cover in North Texas. The attributing factors identified are "climate change, over grazing, fire suppression, distribution of shrub seeds by domestic livestock, and removal of native herbivores" (Herbel et al 1972; Nielson 1986; Schlesinger et al. 1990). Scott et al. (2006) "suggest that carbon and water cycling in semiarid riparian ecosystems of the southwestern U.S. are fundamentally altered by vegetation change." Thirty-two percent of shrub-invaded native grasslands are considered to have restoration potential. Thus, the opportunity for restoration through prescribed fire is substantial, but time sensitive, considering the amount of grasslands already converted to shrublands.

1.4.1. History: Settlement-Fire-Grazing

The presence of whitethorn (*Acacia constricta*) and mesquite (*P. velutina*) was largely limited to riparian areas prior to 1890 (Hastings and Turner 1965). Humphrey (1953)

proposed that the desert grassland of southwestern Arizona and northern Mexico is not true climax vegetation for the region. Instead, they are a subclimax maintained by fire. Suppression of fire has allowed the onset of succession to true climax of low trees, brush, and cacti, with an understory of grasses and low growing shrubs. Mesquite, creosote bush, prickly pear cactus (*Opuntia* spp.), burroweed (*Isocoma tenuisecta*) and snakeweed (*Gutierrezia sarothrae*) are among the principal native invaders with various lovegrasses (*Eragrostis* spp.) as principal nonnative invaders. Humphrey (1958) states, "Had fires continued to sweep the grasslands down through the years to the present with their original frequency, the desert grassland would probably occupy about the same area today as it did prior to the white settlement of the Southwest."

Cox et al. (1993) note that Humphrey's hypotheses as to the occurrence of large, destructive wildfires at 2 to 3 year intervals between 1859 and 1890 are supported by Bahre (1985). Some federal land managers apparently promoted overgrazing in an attempt to reduce timber losses by wildfire (Leopold 1924).

"The decision to create the Santa Rita Experimental Range in 1903 rested on at least two interlocking premises. The first was that it was biogeographically representative of a large swath of Southwestern rangelands. Within its boundaries could be found conditions of vegetation, topography, soils, and climate similar to those of some 20 million acres in Arizona, New Mexico, and Texas (USDA 1952). The second was that it was a representative management unit, similar in size to the larger ranches that dominated the region. Both premises reflected the judgment that the highest economic use of Southwestern rangelands was grazing, such that research aimed at the needs of ranchers and range managers could benefit the entire region" (Sayre 2003). The Santa Rita Experimental Range (SRER) has served as a unique scientific baseline for over 100 years.

Studies of vegetation on the SRER summarized by Humphrey and Mehrhoff (1958) specifically noting the changes in area and abundance of the four most common woody plants: mesquite, creosotebush, burroweed, and cholla (*Cylindopuntia* spp.). Their conclusions included reference to the influence of cattle on vegetation composition, the assertion that fires maintained the desert grassland prior to the introduction of livestock, and that the shrub invasion in these grasslands is due primarily to reduction of range fires.

Clearly, grasslands in central and southern Arizona have undergone dramatic vegetative changes over the past 130 years, including encroachment by shrubs, loss of perennial-grass cover, and spread of non-native species. These changes, however, have not occurred uniformly across the region; the full extent and distribution of these changes are still being discovered. Records from the SRER document "a steady increase of mesquite trees, four cycles of burrowweed eruption and decline, one cholla cactus cycle, interannual and interdecadal variation in native grass composition, and the recent dominance of the nonnative Lehmann lovegrass" (McClaran 2003). Documentation of vegetation change using repeat photography and analyses of the probable causes have included many portions of the Sonoran Desert (Hastings and Turner 1965; Turner, Webb, Bowers, and Hastings 2003).

1.4.2. The Altar Valley Grassland Communities at Present

The Altar Valley has not been immune to grassland habitat alterations and is experiencing several rangeland management challenges because of drought, ranch operations, rangeland conservation actions, and special-status species management. A priority need for the Altar Valley is a range improvement measure that would begin to correct and make better a number of ecological problems that partly stem from range management practices dating to the late 1800s. These ecological problems include the Altar Wash arroyo, an extremely large incised channel that has formed on the valley floor over many decades; the encroachment of mesquite into many of the valley's historical grassland habitats; and the loss of native grasslands to non-native invasive grasses.

One improvement-measure recommendation for the Altar Valley is the reintroduction of fire. As a management tool, fire can restore historic vegetation types by reducing woody-species encroachment; by improving wildlife biodiversity with emphasis on threatened, endangered, and sensitive species; by improving watershed stability and hydrologic function through increased herbaceous vegetative cover; and by creating a watershed with a mosaic of vegetation that will allow fire to resume its historical regime.

1.4.2.1. Fire Plan Coordinating Agencies

To reintroduce fire into the Altar Valley ecosystem, the AVCA, AGFD, ASLD, USDA NRCS, BLM, FS, FWS - AESO, FWS - BANWR, Pima County, and TNC collaboratively developed the AVFMP. The purpose of this collaborative partnership has been to develop, facilitate, and implement scientifically sound land-resource management and conservation strategies in the Altar Valley. All parties have agreed to work together to identify, prioritize, and implement fire management strategies on private, county, and state trust lands to enhance range and watershed conditions.

1.4.2.2. Lead Agency

Acting as the lead agency, the NRCS has agreed to conduct the National Environmental Policy Act (NEPA) review, to pursue Endangered Species Act (ESA) Section 7 consultation with the FWS, and to issue a determination and decision for implementation of the AVFMP. The AVFMP, developed under a Memorandum of Understanding (MOU) with the partners listed above, establishes and designates its signatories as "cooperating agencies." It is important to note, however, that the BANWR and the Coronado National Forest (CNF) have current decisions governing wildland fire use on the lands under their administration within the AVFMP planning area and that this plan will not affect the *Biological Opinion for the Buenos Aires National Wildlife Refuge Fire Management Plan for the 2005-2008 Burn Season* (AESO 02-21-05-F-0243), or the *Wildland Fire Amendment to the Coronado National Forest Land and Resource Management Plan* (June 2005). The remaining signatories to the MOU have agreed to follow the NEPA process as outlined in the NRCS *National Environmental Compliance Handbook* (2003) for the development and implementation of the AVFMP.

1.5. Current Conditions

Ecological conditions in the Altar Valley have improved dramatically since the 1970s and are overall, relatively good compared to previous decades. These improvements are due, in part, to the use of prescribed fire or wildland fire management in the Altar Valley from the mid 1970's to the mid 1990's. Assessment of present conditions in the watershed confirms that the management practices of the past three decades have generally stabilized or improved range conditions.

Carl D. Jones, chaired the development of the Altar Valley Fire Management Plan/Action Guidelines in 1998 (Jones 1998). The Plan consisted of a short narrative and two computer generated maps done by the University of Arizona Advanced Resource Technology Group. The first display map contained numbered fire management blocks delineated by roads, trails and natural features along with land ownership and ranch boundaries. This information was also displayed on the 7.5-minute USGS topographic maps for field use. The second display map was a fire occurrence map showing all natural and human caused fires from 1975 on, along with the location of the start and final burned boundary areas. The information was gathered in the field to be used in the future by fire managers for making fire management decisions. AVCA's *Watershed Action Plan and Final Report* (2001) shows specific problems where at least two of three rangeland health attributes are rated at-risk in the following areas: (1) a large area (approximately 5 by 12 miles) of uplands along the west side of the valley floor; (2) an area of uplands (approximately 5 by 7 miles) on the east-central side of the valley floor; (3) on the valley floor floodplain and its associated Altar Wash arroyo; and (4) in many washes on the east side and south end of the watershed. The remainder of the watershed, and representing the majority of its land area, is rated as stable, intact, or functioning in at least two rangeland health attributes. Trends are generally static with mesquite densities higher than desired and where nonnative grasses replaced native grass species. The vegetative community is not, at its potential with the desired mix of native grassland species. Two factors present serious obstacles to long-term sustainability of the Altar Valley watershed. These include (1) the Altar Wash arroyo, which impairs watershed function by increasing sediment transport, decreasing infiltration, and lowering soil moisture in the valley soils; and (2) mesquite encroachments in the uplands which create higher rates of sheet runoff, evapo-transpiration, erosion, and sediment transport. These trends are recognized as irreversible on human time scales without management intervention, including restoration of fire to the ecosystem.

Conditions vary from place to place in the watershed and there are substantial problem areas. These are reflected in three of the four resource issues the AVCA has specifically identified as concerns: (1) invasive nonnative grasses, (2) woody shrub encroachment into grassland habitats, and (3) erosion in the Altar Wash arroyo (AVCA 2001). These issues will be addressed to some degree through the AVFMP.

1.5.1. Invasive Nonnative Grasses

Nonnative grasses have been both a solution and a problem in the Altar Valley watershed. Although they have been effectively employed over the years to control erosion and restore grasslands, today nonnative grasses are often considered undesirable compared to native grasses. Meyer (2000), for example, found in many upland areas that it was often nonnative grasses that held the soil in place and prevented erosion. Meyer also noted, however, that nonnative grasses dominated in many areas at the expense of native grasses.

The first nonnative grass to appear in the Altar Valley seems to have been Johnson grass. This grass had entered the valley by World War I and was planted in the bottomlands in subsequent decades to be harvested as hay (Sayre 2000). Lehmann lovegrass (*Eragrostis lehmanniana*) was another nonnative grass that was typically used by the Arizona Department of Transportation (ADOT) for erosion control as early as the 1930s. Bermuda grass (*Cynodon dactylon*), Boer lovegrass (*E. chloromelas)*, and other nonnatives were introduced over the years. By the 1950s, the Soil Conservation Service (now the NRCS) was advocating the use of Lehmann lovegrass for range restoration purposes (Sayre 2000). Consequently, nonnatives grasses have been used throughout the watershed for many years, and Lehmann lovegrass in particular continues to dominate where it has been seeded within the watershed. Lovegrass is so successful because it germinates earlier than native perennials, stays green longer, withstands drought and fire, and tends to receive lighter grazing pressure than native grasses. These facts suggest that Lehmann lovegrass and other nonnative grasses, without some management, will persist in the Altar Valley planning area.

Across the West, the ecological value of nonnative species no longer takes precedence over the restoration of native grasses. Although past benefits in preventing erosion by seeding nonnative grasses cannot be denied, restoration of native grass species is now the desirable ecological goal for rangeland restoration. Therefore, the intention of the AVCA is to contain or reverse the spread of Lehmann lovegrass and other nonnative species in the watershed, to encourage strategies that favor the establishment of native perennial grasses and, where possible, to restore grassland communities to a more desirable mix of native species (AVCA 2001).

1.5.2. Woody Shrub Encroachment

According to historical records, vegetation in the Altar Valley prior to Euro-American settlement was predominantly perennial grassland, with mesquite and other shrubs occurring primarily along the margins of Altar Wash and its tributary drainages (Sayre 2000). The uplands were dominated by perennial bunchgrasses. Mesquite densities appear to have increased from south to north through the watershed, with most of the mesquite occurring in the lower northern end of the valley. Cacti, palo verde (*Cercidium* spp.), and other desert shrub vegetation also occurred in the valley's northern lowlands, and increased south to north as elevation decreased through the valley. Larger trees, including oaks (*Quercus* spp.), sycamores (*Platanus* spp.), cottonwoods (*Populus* spp.), and junipers (*Juniperus* spp.) were limited to higher-elevation mountain areas and a few riparian areas. In addition, the broad bottomlands of the valley floor formed a nearly flat

floodplain up to 1.5 miles wide, which supported relatively dense vegetation dominated by sacaton grass (*Sporobolus wrightii*).

The encroachment of mesquite from the Altar Valley's lowlands into its upland grasslands appears to have begun with the formation of the Altar Wash arroyo (about 1890). In the years following the initial formation of the arroyo, giant sacaton grasses in the valley's bottomlands were replaced by Johnson grass (*Sorghum halapense*) and eventually by mesquite. Over the years, mesquite continued to expand from the margins of the Altar Wash and its tributary drainages into the valley's uplands. This seems to have occurred at gradually increasing rates and was substantially accelerated by the drought of the mid-1950s (Sayre 2000). Today, mesquite occurs in excessively high densities across approximately one-third of the watershed and represents a potentially permanent shift in vegetation from grassland to shrubland (AVCA 2001; Gori and Enquist 2003).

The effects of mesquite encroachment can be severe. For example, when mesquite canopy cover exceeds about 16 percent, herbaceous cover is greatly reduced (Kincaid et al. 1959), which significantly increases erosion rates, since the amount of bare ground and soil movement increases as vegetative cover decreases. Experiments in the SRER showed that 16 times as many mesquite seedlings were established on bare ground as in vigorous stands of perennial grasses (Glendening and Paulsen 1955, as reported in USDA 2005, sec. 3, p.70). Moreover, once established, growth of young mesquite was severely restricted in good stands of grass (Wright et al. 1976 as reported USDA 2005, sec. 3, p.70). Because of such factors, numerous areas of soil instability were found in certain ecological sites within the watershed, and mesquite occurrence negatively affected all three indicators of rangeland health, soil stability, biotic integrity, and watershed function (Meyer 2000).

Considerable wildfire suppression efforts, coupled with the uninterrupted invasion of mesquite and brush species, have created vegetative components that are not consistent with the historic vegetation that sustained the natural fire regime in the past.

1.5.3. Erosion in the Altar Watershed

Riparian habitat, particularly in the arid Southwest, is highly important to both humans and wildlife. While only 2 percent of Arizona's landscape is composed of perennial rivers, streams, and other water resources such as wetlands and springs, over 80 percent of Arizona's wildlife depend on these aquatic resources and their associated riparian habitat. Over the past century, however, 90 percent of these water resources have been altered, degraded, or lost. The emphasis toward improving watershed health as identified in this plan, will help maintain riparian systems and allow them to persist as high-quality wildlife habitat.

According to Sayre (2000) the Altar Valley, consisting of the Brawley Wash-Los Robles Wash and drainages of the Rio Concepción, has changed dramatically over the past 120 years, mostly because of the direct and indirect effects of human land uses. The most

drastic changes occurred between the 1890s and 1930s through the combined effects of drought, uncontrolled grazing, floods, and fuelwood cutting. Generally, heavy stocking rates during the drought of 1898–1904 resulted in a massive loss of forage and vegetative cover within the watershed, followed by a period of flooding in the winter of 1904–1905. Heavy flood flows during this period probably triggered the formation of the Altar Wash arroyo, which triggered a number of further effects. As the arroyo grew, runoff from the surrounding mountains funneled rapidly through it and out of the watershed rather than spreading across the floodplain and percolating into the bottomland soils. This caused the alluvial water table to drop, which favored woody species (e.g., mesquite) in the bottomlands at the expense of perennial grasses. In addition, "headcutting" from the Altar Wash arroyo caused smaller arroyos to form at the mouths of its tributary washes. These smaller arroyos cut their way into the uplands, forming gullies and bank erosion. This process often caused vegetation loss in the washes and prevented re-growth. Although some of these processes have been slowed or reversed over the years, others, especially erosion in the Altar Wash arroyo and mesquite encroachment, have continued and remain serious problems.

The primary types of erosion occurring in the Altar Valley are sheet, rill, stream channel, and gully erosion. Sheet and rill erosion account for a majority of erosion in the watershed in terms of sediment produced; however, stream channel and gully erosion—while localized—are more visible and severe (Westland Resources 2000). In addition to the Altar Wash arroyo, many smaller arroyos have formed within the watershed's tributary washes—the result of "headcutting" (which moves up the washes from their mouths at the Altar Wash arroyo) and gully erosion (which moves downward from the steeper slopes as runoff cuts through inadequately vegetated uplands and washes). The results of these processes have created a network of incised arroyos and washes throughout the watershed, especially in the uplands of the watershed's east-central and southern portions. All these types of erosion produce excessive quantities of sediment, much of which finds its way to the Altar Wash. Under present conditions, it is estimated that approximately 900 acre-feet of sediment per year is generated from the watershed, of which approximately 532 acre-feet is transported past SR 86 annually (Westland Resources 2000).

The development of the Altar Wash arroyo has resulted in the loss of much of the valley floor's most productive soils and usable land and also lowered the alluvial water table. From 1936 to 1987, for example, about 341 acres of land were lost to bank erosion in the arroyo between SR 86 and SR 286 alone, and it is estimated that approximately 7 acres of land per year continue to be lost in this reach (Westland Resources 2000). Furthermore, over the years sediment removed from the wash (and elsewhere in the watershed) has been deposited on agricultural and rangelands in the northern end of the watershed in the Garcia Strip (part of the Tohono O'odham Reservation) and Tortuga Ranch, where 1–2.5 feet have been deposited across several thousand acres (Sayre 2000). As the arroyo continues to widen, roads, road crossings, and various ranch facilities—including corrals, barns, fences, water tanks, and levees—have been lost or suffered the impacts of sedimentation. The costs of maintenance and cleanup on SR 286 because of sediment deposition, for example, total approximately $45,000 per year (Westland Resources

2000). When implemented, the AVFMP will begin to slow the erosion associated with washes in the planning area by increasing the herbaceous ground cover and limiting mesquite encroachment.

The AVCA has continued efforts to control erosion on the side channels of the main Brawley Wash. In 2006 two workshops were sponsored for local ranchers and agency personnel to demonstrate methods of controlling erosion along ranch roads. These workshops included actual installation of several types of "road dikes" on several ranches. In 2003, several dikes were repaired at Palo Alto Ranch as well using an AZDWR 319 Grant in combination with private funds, although flooding during the summer of 2006 caused some of these repairs to fail. Smaller rock and brush erosion structures have been installed on other ranches. The Anvil Ranch supported an Americorps Team in 2000 that spent two weeks constructing several types of erosion control structures on side channels. The Los Encinos Ranch used NRCS cost-share funds to complete brush control and land smoothing in a pasture with major head cuts on a side channel in the late 1990's.

Martin and Morton (1993) studied the results of mesquite control on paired gully headcuts on year-round grazed and rotation grazed areas on the Santa Rita Experimental Range. Prior to mesquite control grass densities were low under both grazing regimes. After three years the perennial grass densities was greater in areas where mesquite was controlled. The study documented that soil loss, advances in headcuts, and changes in gully depth were less in areas of mesquite control. On four pairs of watersheds, there was more total runoff in areas where mesquites were alive than in areas where mesquites were dead. Increases in grass densities associated with mesquite control can be effective in slowing this type of arroyo cutting.

Altar Valley ranchers have undertaken a variety of efforts to control erosion over the years. Grasses have been restored in many areas, which has slowed or eliminated sheet and rill erosion, while many measures to combat gully and stream channel erosion have also been implemented. In the early years (1920s and 1930s) of the Altar Wash arroyo, for example, earthen spreader dams were constructed to lift floodwaters out of the arroyo and across the adjacent floodplain (Sayre 2002). Spreader dams were also built in other areas, such as Arivaca Wash and other tributary washes in from the 1930s to 1950s (Sayre 2000). Earthen spreader dams, however, do not withstand continued flood flows, and many have been washed out over the years (Sayre 2002).

Other past erosion control practices include (1) contour plowing (to slow runoff and increase infiltration); (2) construction of earthen reservoirs equipped with spillways and sandtraps (to prevent washouts and capture sediment); (3) construction of dikes and drop structures (to prevent "headcutting"); (4) installation of spillways, culverts, and water bars around stocktanks and roadways (to prevent erosion); and (5) placement of rock dams and gabions in gullies (to capture sediment). In addition, the introduction of rotational grazing management in the mid to late 1970s contributed significantly to the slowing of erosion. All these remedies have resulted over time in watershed improvements; however, more work is needed in an integrated approach to built

additional structures and replaced old structures.

1.6. Current and Past Fire Management Projects

Recently, NRCS, ASLD, and Altar Valley ranchers have been working together to develop Coordinated Resource Management Plans (CRMP) for some ranches. These CRMPs are more comprehensive than cooperator agreements and have a proposed planning horizon of 10 years. The CRMPs establish specific range management goals for a subject ranch; describe the grazing systems that the rancher agrees to implement; and details planned improvements (fencelines, stocktanks, etc.) and monitoring strategies. According to the NRCS, CRMPs have been completed and signed for four Altar Valley ranches; five more are in various states of completion. The AVCA is supportive of programs designed to stimulate local industries that reduce heavy fuels and remove invading mesquite on upland areas located in the planning area. Contracts for fuel wood and other commercial uses are also supported by the AVCA. Habitat enhancement treatments that have been employed in the analysis area intermittently since 1966 include chaining, fencing, grazing rotation, and prescribed burning.

2.0 Altar Valley Fire Management Plan 2007

2.1. Need for the AVFMP

Fire played an important role in the Altar Valley's ecology prior to Euro-American settlement. According to Bahre (1985), fires were "fairly frequent" in southern Arizona grasslands prior to 1882 and much larger in aerial extent within the grasslands; cessation of major grassland fire preceded the brush invasion of the 1890s. Kaib (1998) further suggests that desert grasslands in this area likely burned once every 8–12 years. In addition, evidence suggests that both Native Americans and early settlers in the Altar Valley used fire as a management tool (Sayre 2000). In the Southwest, the episodic occurrence of years with high fire activity has been correlated with El Niño and La Niña events (Swetnam and Betancourt 1990). Those fire regimes likely played a crucial role in maintaining the area's grasslands by suppressing woody species and encouraging new growth (Sayre 2000, 2002). However, fire incidence in the Altar Valley has decreased dramatically during most of the twentieth century. This is a result of several factors including:

- discontinuation of managed range fires with the introduction of wood fencing in the 1910s and 1920s,
- lack of sufficient herbaceous cover to sustain fires,
- increasingly effective and thorough fire suppression policies, and
- ESA considerations.

In recent years, the steady increase of woody species and decrease of herbaceous species in the Altar Valley has resulted in a renewed interest in restoring fire to the ecosystem—both in its natural form and as a management tool. During the *Altar Valley Watershed Resource Assessment*, Meyer (2000), noted (1) that numerous grassland areas within the

watershed that had recently been burned showed vegetative components similar to presettlement conditions; (2) that burning appeared to be an effective control of small mesquite trees and reduced the vigor of midsized trees; and (3) that live basal areas, grasses, and forage production were significantly greater, and bare ground and trees and shrubs were significantly less, in burned areas as compared to unburned areas within Granitic Hills ecological sites located in the watershed.

The cooperating agencies are proposing the development of the AVFMP to allow for the re-introduction of fire as a functioning component of the ecosystem of the planning area. One of the main objectives of this plan is to set forth a process to address ESA compliance/recovery goals, while implementing a FMP that reestablishes fire as a component of the grassland ecosystem in the planning area. The AVFMP, once implemented, will be in effect for a 10-year period. The AVFMP fire prescriptions will be annually reviewed and periodically revised according to monitoring results.

The AVFMP and associated Biological Assessment (BA) will disclose fire prescriptions parameters. Prescribed fire will be the primary management tool used across the landscape to produce and maintain a mosaic of shrub and native grasslands in near-historic conditions with naturally functioning riparian systems, while reducing woody plant encroachment of upland vegetation communities. Resultant vegetation communities will approach historic condition and function (Meyer 2000), enhancing the distribution of native vegetative communities. Restoring the historical vegetation, fire regime, and Condition Class into the ecosystem of the planning area will maintain a mosaic of vegetative landscapes with irregular or clumpy appearance and patterns, age structure, and cover types. The cooperating agencies anticipate that the desired historic vegetative composition and pattern will enhance native grasses and will improve range and watershed health and wildlife biodiversity.

The goal of prescribed fire management within the AVFMP is to maintain a mixture of woodlands, shrublands and grasslands while reducing woody plant encroachment and reducing invasive plant species through the reintroduction of fire as a naturally functioning and sustaining component of the ecosystem.

2.2. Prescribed Fire Management Goals

The cooperating agencies have established the following primary goals of the AVFMP:

1. Integrate the fire management activities of all major non-Federal land users of the Altar Valley.
2. Minimize adverse effects of prescribed fire on listed, and candidate species under the Act, as well as other fish and wildlife resources.
3. Provide for habitat enhancements for listed and candidate species under the Act, as well as other fish and wildlife resources.
4. Provide a voluntary landowner agreement template through which a landowner may participate in the implementation of prescribed fire.
5. Provide long-term watershed improvement.

These goals provide the opportunity to apply two evaluative tools: 1) fire regime condition class and 2) range management classification. The first of these is applied in the context of forestry and forest management. The second is applied in the context of range management and is the Similarity Index of the MLRA and Ecological site guides.

2.2.1. Fire Regime Condition Class

The desired future condition of federal land within the AVFMP planning area is a return to Condition Class 1 (USDA 2003).

AVFMP lands were evaluated for Fire Regime Condition Class—a general classification of the role a fire would play across a landscape in the absence of modern human mechanical intervention. To support national-level fire planning and risk assessment, the FS produced fire regimes from seven coarse-scale spatial data layers for the contiguous United States. They developed five categories of natural (historic) fire regimes based on fire frequency (i.e. the number of years between fires) and severity of fire on dominant overstory vegetation (Schmidt et al. 2002). The severity of fire was characterized as either low (less than 75 percent replacement) or high (greater than 75 percent, which results in stand replacement).

The majority of AVFMP lands are composed of natural fire regime 1. The five historic regimes are as follows:

- Regime I: 0–35 years, low
- Regime II: 0–35 years, high
- Regime III: 35–100^{+} years, low
- Regime IV: 35–100^{+} years, high
- Regime V: 200^{+} years, high

Condition Class is the classification of the extent of departure from the natural fire regime. Condition Class 1 lands have a natural range of vegetation components, soil and hydrology function, insect and disease populations, and limited or no presence of nonnative or invasive species. Condition Class 2 lands moderately depart from historic conditions due to decreased watershed function; increased erosion; altered disease and insect populations; and increased presence and expansion of shrubs, trees, and invasive species. Condition Class 3 lands significantly depart from their historic regime due to high encroachment of shrubs and invasive species.

According to Schmidt et al. (2002), 82 percent of AVFMP lands are categorized as fire regime I and Condition Class 1 lands. The remaining 18 percent of the planning area is classified as Condition Class 2 lands. Because Condition Class categories are based on coarse-scale data that is intended to support national-level planning, any interpolation of this data for localized conditions may not be valid. Therefore, local agencies are asked to provide data for localized conditions. “With few exceptions, the overall rangeland

resources in the Altar Valley are healthy, stable, and in functioning (good) condition" (Meyers 2000).

Condition Class I for this vegetation type would be open park-like savanna grassland or woodland, or frequent surface fires of mixed severity maintain shrub structures. Surface fires typically burn through the understory removing fire-intolerant species and small-size classes of fire-tolerant species; typically removing less than 25 percent of the upper layer, thus maintaining an open single-layer overstory of relatively large trees. Mosaic fires create a mosaic of different-age classes, post fire grassland, savanna woodlands, or open shrub patches, generally less than 40 hectares [100 acres], by leaving greater than 25 percent of the upper layer. Intervals can range up to 50 years in systems with high temporal variability. (Schmidt et al. 2002, p.10)

The BLM has developed specific desired future conditions for semidesert grassland and desert scrub communities described in the *Arizona Statewide Land Use Plan Amendment for Fire, Fuels and Air Quality Management Finding of No Significant Impact (FONSI) and Environmental Assessment* (USDI 2004):

Perennial grasses to cover their historic range of variability, annual grass cover is reduced, an adequate cover and mix of natural plant species, which have good vigor, and are dominant. In terms of fire management and fire ecology, the desired future conditions are to promote fire control or reduce exotic annual weeds, such as red brome (*Bromus rubens*), and to limit woody vegetation, such as mesquite to non-hazardous levels. (USDI 2004, p. 2–3)

Forest-wide desired conditions, goals, and objectives for the vegetative types within the CNF are identified in the *Wildland Fire Amendment to the Coronado National Forest Land and Resource Management Plan* (USDA 2005) and include the following:

<u>Desert scrub</u>: Protect the sensitive species while returning selected desert scrub back to a more natural grassland condition. Density of desert scrub is reduced through establishment of a natural fire regime. Fires occur every 5 to 10 years.

<u>Grassland</u>: Maintain grasslands to existing extent and expanded where possible. Woody species occur at near natural levels. Species composition of grasses is predominantly native; exotic species are not causing decline in vigor or density of native species. Historically, fires in this ecosystem occurred every 5 to 10 years. When grasslands are in good condition fire can be used as an effective tool to control a variety of invading species. Grasslands in the desired condition hold a great variety and abundance of species in the climax communities and account for much of the herbaceous production of the southwest. The composition of perennial grasses varies in location with a wide variety of cool and warm season grasses. Shrubs are also a key element in this ecosystem. Some tree species such as piñon-juniper or mesquite will be present but should not be major component of the flora. This variety in plant life will provide forage for wildlife and domestic livestock on a year-round basis.

Woodland: Should have a divergent mix of landscapes, such as open areas and scattered groups or clumps of woodland tree species. Open canopies, light grass and ground fuels will create an environment resulting in flame lengths of four feet or less, which is desirable to prevent high intensity fires. A natural fire regime consists of fire every 10 to 30 years in piñon-juniper vegetation type and every 50 to 100 years in oak-woodland. Stand replacement fires may occur every 300 years or more.

2.3. Use of Fire in the Past

Historically natural wildland fire regimes within southern Arizona grasslands have limited mesquite and woody vegetation invasion, have reduced some types of noxious weeds, and have increased grass and forb production. The restoration of natural fire regimes into the Altar Valley is a goal of both cooperating agencies and many Altar Valley ranchers who wish to reintroduce prescribed fire onto their lands as an integral component of ranch management. The AVFMP is complex and requires many layers of agency and individual oversight to implement a strategy to reintroduce prescribed fire as a critical natural process. Timing prescribed fire and the type and arrangement of fuels across the landscape are critical components considered within this plan. The AVFMP will analyze existing wildland fuel loads by vegetation type and recommend specific parameters for prescribed fire to meet objectives of overstory reduction while maintaining or improving Threatened and Endangered (TE) species habitats. The fire management activities analyzed in this section include prescribed fire designed to improve rangeland and watershed conditions in the Altar Valley and conducted under specific parameters on-the-ground fire management, control, and monitoring activities and practices normally associated with prescribed fire management.

Prescribed fire is usually ignited by handheld drip torches or by helicopter drops of an ignition agent. Natural fires are ignited by lightning or unconfirmed causes. In both cases, a variety of firefighting equipment (e.g., fire engines, water tankers, pickup trucks) and personnel are maintained on site to manage and control the fire. Most wildland fire confinement, containment, and control is established around existing roads or other infrastructure allowing access for fire suppression activities. However, fire lines are often constructed by hand crews or mechanical means during wildland fire events for confinement, containment, and control of the fire. Such confinement, containment, and control lines may be constructed anywhere in or adjacent to the burn area.

Wildland fires do not typically consume all existing vegetation within the burn perimeter but rather burn in a mosaic pattern. The size, pattern, and intensity of wildfires generally depend on fuel loads, wind, humidity, and temperature. On average, 25 to 50 percent of vegetation will remain unburned in most range fires (Sayre 2002). Fires may burn through xeroriparian areas that have higher fuel loads. Cool-season and low-intensity fire in xeroriparian areas will consume fine fuels, but have little to no effect on the overstory xeroriparian vegetation. Since some xeroriparian areas do have moderate to heavy fuel loading, a summer season, high intensity fire could cause high mortality of overstory xeroriparian vegetation.

Fire intensities can be effectively controlled through planning, appropriate prescriptions, and timing. Prescribed fire conducted under this plan would not intentionally be stand-replacement fires or fires that would appreciably reduce overstory xeroriparian vegetation.

This section of the AVFMP will outline the analysis of vegetative, atmospheric, geographic and other influencing components of wildland fire in the Altar Valley planning area. The analysis of existing data and information will be used to establish specific prescribed fire conditions for prescribed fire within the planning area for range and watershed improvement while minimizing negative effects on TE and wildlife species.

2.3.1. Vegetation Management Objectives and Range Condition Classification

Specific objectives of each landscape fire are to create a mosaic of burned and unburned fuels within the range of allowable fire intensity thresholds. Range condition objectives will be based on the Similarity Index, "the percentage of a specific vegetation state plant community that is presently on the site" (NRCS 2006). The objective within each vegetative community is to maintain a similarity index of 0.6 or greater (formerly good to excellent condition) per NRCS Ecological Site Description (Interagency Technical Reference 1996 Sampling Vegetation Attributes). Established pace frequency transects will be read as part of the long-term monitoring plan. NRCS may establish additional frequency monitoring transects as needed.

Objectives:

1. Within shrub-invaded native grasslands**,** kill 30 percent to 70 percent of the half shrubs, and maintain native-grass dominance with mesquite densities at less than 10 percent.

2. Within shrub-invaded nonnative grasslands, top kill 30 percent to 70 percent of mesquites less than 4 inches in diameter stimulate native grass production, and maintain mesquite densities at less than 10 percent.

3. Prescribed fire have been indefinitely deferred for Southwest desertshrub vegetative associations. Although prescribed fire is not deferred in desert scrublands, these will require periods of favorable weather conditions to created continuous fine fuels at greater than 800lbs per acre to implement prescribed fire. Prescribed fire will be implemented to maintain native perennial grass cover at the historic range of variability with adequate mix of native shrub species in good vigor.

4. Within mesquite woodlands, top kill 20 percent to 50 percent of mesquites less than 6 inches diameter, and maintain total shrub and mesquite canopy cover at 10-25 percent.

5. Within deciduous riparian habitats, including xeroriparian habitats and mesquite bosque, periodic cool season burns can be used to reduce fuels with a 1-hour time lag, to

maintain tree overstory with no fuel laddering, and to maintain mesquite densities greater than 60 percent in clumps of mature trees greater than 6 inches in diameter at root collar (drc).

6. Within oak, juniper, or piñon-oak canyons, reduce the 1-hour-time-lag fuels (0.01-to 0.125-inch diameter) by 30 to 80 percent, the 10-hour-time-lag fuels (0.26-to 0.99-inch diameter) by 10 to 40 percent, the 100-hour-time-lag fuels (1-to 3-diameter) by 1 to 10 percent, and 1,000-hour-time-lag fuels (3.1-to 12-inch diameter) by 1 to 20 percent.

3.0 Project Description

The AVFMP proposes to implement prescribed fire management to achieve improved range and watershed health. It establishes measures to fully comply with the Act and to minimize adverse effects to federally listed species that could occur during the implementation of prescribed fire. It includes monitoring and an adaptive management program that allows the AVFMP to adjust to new information and to do so as outlined by the regulatory requirements. It also provides Altar Valley ranchers a clearly defined process that will remain predictable over the life of the plan.

If Arizona State Land Department, Division of Forestry fire management policy changes or is amended in the future, the Altar Valley Fire Management Plan will amended to reflect those changes. (2-6-07)

3.1. Wildland Fire Management

The AVFMP in accordance with the *Wildland Fire Use and Implementation Procedures Reference Guide (*WFIP; USDI/USDA 2005) defines wildland fire as any nonstructural fire that occurs in the wildland. Two distinctive types of wildland fire have been defined as follows:

- Wildfire: An unplanned, unwanted wildland fire, including unauthorized human-caused fires, escaped prescribed fire projects, and all other wildland fire in which the objective is to put out the fire.

- Prescribed fire: Any fire ignited by management actions to meet specific objectives. A written, approved prescribed fire plan must exist and NEPA requirements (where applicable) must be met prior to ignition.

Fire management strategies will range between the following tactics:

- Full suppression: To complete the control line around a fire, any spot fires, and any interior islands to be saved. Burn out any unburned areas adjacent to the fire side of the control line and cool down all hot spots that are immediate threats to the control line until the line can be expected to hold under favorable conditions.
- Containment: to surround a fire or spot fires with control lines, as needed, that can be expected to hold the fires spread under prevailing and predicted conditions.

• Conditional suppression: To limit spread within a predetermined area principally through natural or pre-constructed barriers.

Suppression actions may be minimal and limited to surveillance under appropriate conditions. Specific response action will be depend on the expected fire behavior within specific FMUs that are predicted either to remain within prescription guidelines or to burn outside of them. A WFIP will be initiated for all wildland fires within the AVFMP area in accordance with each agency's polices and guidelines. However, only the most complex fires being managed for resource benefits will require completion of all three stages of a WFIP. The three stages are Stage1—Initial Fire Assessment; Stage 2—Short-Term Implementation Actions; and Stage 3—Long-Term Assessment and Implementation Actions (USDI/USDA 2005). Response to wildland fire occurring on state lands will be consistent with Arizona Revised Statute (ARS) 37-623 and the policy of the Arizona State Forester to organize and suppress wildland fire to minimize costs, resource loss, and for public and firefighter safety. The "least cost containment" policy as described in the state statute does allow for flexibility of response to ensure minimal fire spread across determined containment lines.

3.1.1. Wildland Fire Ignition Sources

Wildland fires in the AVFMP area originate from three primary sources: natural ignitions (lightning), human-caused fires, and planned ignitions (i.e., prescribed burns). Natural ignitions are the most common source occurring primarily between late spring and early summer, with the most significant fires from natural ignition occurring during May, June, and early July before the advent of monsoon storms. Fire-ignition data from 1979 to 2004 indicate an average of 74 natural ignition fire responses annually for this 25-year period. In addition, there is field evidence of lightning starts naturally extinguishing without direct management or suppression action. During this time frame, less than 73,129 acres (12 percent of the AVFMP area) had burned with varying intensity. The size of the suppressed fires ranged from 5 to 10,000 acres with the average fire size being approximately 930 acres. With the proposed change in fire management, the average fire size is predicted to increase and the fire interval for any affected area is predicted to shorten, as a more naturally functioning ecosystem evolves and prescribed fire becomes the primary management tool for maintaining range and watershed health.

Between 1979 and 2004, there have been 101 human-caused fires, which have burned 85,091 acres within the AVFMP area during this period. While these types of ignitions have the potential to occur at any time of the year, they are most likely to occur during the peak fire season—April through July—of each year. ASLD Division of Forestry records indicate that approximately 90 percent of human-caused fires annually occur between April and the first two weeks of July.

The third ignition source is planned ignitions, or prescribed burns, initiated by agency land managers and private landowners. Over 53,284 acres have been treated within the AVFMP during the past five years. A majority of the treated areas have not been reburned by prescribed fire within the past three years. Prescribed fire is specific to

vegetation types, individual FMU objectives, seasons, and specific burning parameters. In addition to reintroducing fire into the AVFMP analysis area, objectives such as wildland fuel reduction to minimize effects of subsequent prescribed burns, minimizing possible effects of catastrophic wildland fire, and retaining site-specific habitat components can be achieved.

3.1.2. Wildland Fire Seasons

Wildland fire seasons have been grouped into cool, summer, and monsoon categories based on the season of occurrence. Wildland fires occurring from October through April is considered cool season fires. These fires are typically less frequent in occurrence, burn at low intensities, are small in burn acreage, and reduce light fuel with minimal effects on existing vegetation components.

Wildland fires occurring from May to mid-July, are considered summer season fires. Summer season ignitions are expected to have the greatest potential to carry wildland fire, to burn larger in size, and to be more diverse in intensity than fires in other seasons. The location of ignition, expected direction of spread, and current and predicted fire behavior will be evaluated for potential suppression response. Fires within the summer season that are within prescription will be continually monitored. In some cases, the potential for stand-replacement events or proximity to suppression zones will require that full suppression activities be implemented.

Ignitions that occur from mid-July through September are considered Monsoon (wet season) fires. Wildland fires within the monsoon vary in size and intensity according to the relative amounts of live fuel moisture due to vegetative green-up following the onset of the monsoon weather pattern. However, the time lapse between precipitation events will be considered in each WFIP.

3.1.3. Fuel Types

According to Sayre (2000), vegetation in the Altar Valley prior to Euro-American settlement was predominantly perennial grassland, with mesquite and other shrubs occurring primarily along the margins of the Altar Wash and following the margins of its tributary drainages into the uplands. The uplands themselves were dominated by perennial bunchgrasses. Mesquite densities appear to have increased from south to north through the watershed, with most occurring in the lower, northern end of the valley and very few at the higher, southern end. Cacti, paloverde, and other desert shrub vegetation also occur in the valley's northern lowlands, and increase south to north through the valley. Larger trees—including oaks, sycamores, cottonwoods, and junipers—were limited to the higher elevation mountain areas and the few riparian areas within the analysis area containing surface water (e.g., Arivaca Creek). In addition, the broad bottomlands of the valley floor formed a nearly flat floodplain up to a mile and a half wide, which supported relatively dense vegetation dominated by sacaton grass.

According to Gori and Enquist (2003), vegetative change in southern Arizona,

southwestern New Mexico, and northern Mexico grasslands have been extensive and dramatic. Native grassland with low shrub cover is limited to 15 percent of current and former grassland, with some grasslands restorable to native conditions through prescribed burns and grazing rest (29 percent of current and former grasslands), while shrub cover has exceeded a threshold producing a type conversion from grassland to shrubland in 36 percent of the historic extent of grasslands within the ecoregion. Gori and Enquist (2003) also developed a series of six grassland classes or types as well as threshold values for shrub cover. These grassland types and ranking system were used in combination with agency vegetative data and Sayre's (2000) vegetative data to describe and map vegetative types across the Altar Valley and to assign fire danger rating fuel models and fire behavior prediction fuel models to each major vegetative type. Table 1 describes fuel models, fire danger rating models, and predicted fire behavior for each major vegetative type.

Table 1. Expected fire behavior by fuel type

Fuel type	Fuel model	Fire danger rating model	Flame length (ft)	Rate of spread ft/hr (ch/hr)
Grassland	1	L and N	4–7	3,950–13,200 (60–200)
	1 and 3	L and N	6–12	5,000–6,000 (75–90)
	3	L and N	12–20	5,950–16,500 (90–250)
	3	S	6	2,300 (35)
Mesquite	1 and 3	T	6	2,100 (32)
Semi desert shrubland and desertscrub	1	F	19	4,950 (75)
	1	F	6	2,100 (32)
Deciduous Southwest	9	E and T	6	2,300 (35)
	1	E and T	19	4,950 (75)
	3	B and T	19	4,950 (75)
Oak-juniper-piñon	1 and 3	B and T	6	2,100 (32)

Source: *The National Fire Danger Rating System—1978 USDA Forest Service GTR INT*-(USDA 1978).[a] See Appendix A for the National fire Danger Rating System definitions.

The normal or extreme fire years are generally determined by two components. First is the Burning Index (BI), a relative number related to the contribution that fire behavior

makes to the amount of effort needed to contain a fire of a specific fuel type. The calculated BI falls on a scale of 1–100 in which 1–11 is no fire danger, 12–35 is medium fire danger, and 35–100 is high fire danger. Second is the Keetch-Byram Drought Index (KBDI), a number representing the net effect of evapotranspiration and precipitation in producing cumulative moisture deficiency in the upper soil and duff layers. For the KBDI index, 0 is the point of no moisture deficiency, and 800 is the maximum drought possible. A KBDI of 0–200 occurs during the winter season when soil and large class fuel moisture are high and do not contribute to fire. A KBDI of 200–400 is typical for late spring growing season conditions when fine fuels are drying and may contribute to fire spread and intensity. A KBDI of 400–600 is typical for late summer pre monsoon conditions when litter and dead fuels will actively contribute to fire intensity. Finally, a KBDI of 600–800 occurs during drought conditions when heavy fuels will be fully consumed; downwind spotting from firebrands will occur, and live fuel will actively burn. Normal fire years are defined as those with a BI below 84 and a KBDI below 600 on May 15 of each year.

3.1.4. Wildland Fire Intensity

The two major fuel types, as classified in southeast Arizona within the *Wildland Fire Suppression Tactics Reference Guide* (NWCG 1996), found within the Altar Valley watershed are grass and shrub/brush fuels. These two fuel types have differing fire behaviors. Grass fuel types react quickly to changes in relative humidity and can result in high-intensity, fast-moving, erratic fire spread. Grasses are important for the ignition of shrub/brush fuels in flat terrain and areas without interlocking crowns. Shrub/brush fuels can produce high-intensity rapid-spreading fires by wind and topographic features. Relative humidity (RH) less than 40 percent, with 1-hour and 10-hour fuel moisture less than 10 percent, can allow for high ignition potential with moderate burning conditions. As RH decreases below 25 percent and fuel moisture drops below 7 percent, quick ignition with a high rate of spread and high burn intensity (near-total fuel consumption) occurs.

Changes in weather patterns greatly influence fire behavior. West-southwest winds, with accompanying low humidity, occur from late March to early May and create mostly wind-driven fire. Hot, dry, unstable conditions exist prior to the monsoon season of late May through early July, when dry lightening strikes most often occur, leading to high-intensity fuel, slope, and wind-driven fires. Monsoon activity is prevalent from mid-July through September and is accompanied by higher humidity, sporadic rainfall, and less wind, producing reduced fire behavior. After the monsoon, dry and mild conditions of early fall can increase potential fire behavior before the onset of winter. This range of parameters and predicted severity of fire effects will be used to determine strategy decisions—full, conditional, or no suppression—for wildland fire within any FMU. Similar wildfire management prescription tables have been developed in southeastern Arizona to predict fire effects by vegetative type during varying weather conditions. These fire-effects severity tables disclose the predicted weather conditions that will produce the desired severity of wildland and prescribed fire necessary to meet vegetative objectives within a specific fire management unit (Helbing 2004; USDI 2005a.).

The parameter guidelines contained in Table 2 will also be used to guide the creation of fire prescriptions in management-ignited prescribed fires. Project-level burn plans with prescriptions will use the elements of relative humidity, wind speed, and ambient air temperature for fuel modeling to predict fire behavior and desired intensity level. Topographical influences of slope and aspect will be mitigated and compensated through firing techniques, timing, and firing patterns.

3.1.5. Fire Size

Exact fire size or actual acres burned is not practical to determine. Variable conditions at the time of ignition, location, and season will influence fire behavior throughout the burn period. Geographic features such as ridges, canyon bottoms, roads, and trails will become natural hindrances to fire movement. Suppression actions will include the use of these features for firefighter safety and to reduce suppression costs. Using suppression actions in addition to geographic features may be necessary to protect private property, specific TE species or their habitat features.

Table 2. Ignition parameters

Ignition season Vegetation type	Minimum Relative humidity (%)	Maximum Wind speed (mph)	Maximum Ambient temperature (^{o}F)
Cool season ignitions			
Oak-piñon-juniper	5	15	75
Riparian	25	20	75
Mesquite-grassland	2	15	75
Semi desert shrubland	2	15	75
Grassland	2	15	75
Summer season ignitions			
Oak- piñon-juniper	2	15	95
Riparian	2	20	100
Mesquite-grassland	2	15	100
Semi desert shrubland	2	15	100
Grassland	2	15	100
Monsoon ignitions			
Oak-piñon-juniper	20	15	75
Riparian	30	20	70
Mesquite-grassland	15	30	80
Semi desert shrubland	15	30	70
Grassland	15	30	85

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Although there will be limit or restriction on the total number of acres affected by a single prescribed fire event or by multiple burning events, fire-intensity level acreage

ceilings obtained through prescribed fire will be established. These "constraints" will further guide the management of the prescribed fire for resource benefit. If a wildland fire being managed under prescribed fire for resource benefit is expected to burn at an intensity level that exceeds the prescription for a FMU or for the collective fuel type, appropriate measures will be taken to manage the fire into prescription or suppress it as per the WFIP Periodic Fire Assessment. The ability to successfully manage wildland fire within prescription will be dictated by several factors such as burning conditions, fire size, management resources, and firefighter safety. An adaptive management process based on the analysis of the final fire results will be used to predict outcomes and suggest management actions for similar wildland fire ignitions, with similar vegetative fuel types, for the current year and in future prescribed fire planning.

Table 3 quantifies the maximum acreage thresholds permitted relative to the prescription guidelines and expectations for a particular fire event. These maximum threshold levels are not attainment goals or objectives but are maximum desired outcomes of prescribed fire, taking into account habitat requirements of TE species or desired vegetative structure objectives for a particular FMU.

Table 3. Acreage limits

Vegetation associations [Fire Behavior Model]	**Total acres**	**Low**[2] % of area (number of acres)	**Moderate/High**[2] % of area (number of acres)
Nonnative or Lehmann Grassland Fire Behavior Predictive Fuel Model 3	5,883	60 (3,530)	10 (588)
Johnson Grass /Sacaton/Russian Thistle Fire Behavior Predictive Fuel Model 3	51	45 (23)	10 (5)
Native Grass Fire Behavior Predictive Fuel Model 1	105,516	30 (31,655)	10 (10,551)
Lehmann/Native Grass Mix (depending on species and density) Fire Behavior Predictive Fuel Models 1 and 3	16,262	60 (9,757)	10 (1,626)
Mesquite Fire Behavior Predictive Fuel Model 3	78,380	60 (47,028)	10 (7,838)
Mesquite Fire Behavior Predictive Fuel Model 1	18,089	60 (10,853)	10 1,809)

Semi desert shrubland Fire Behavior Predictive Fuel Model 1	46,402	60 (27,841)	5 (2,320)
Southwest Desertscrub Fire Behavior Predictive Fuel Model 1	0	Confinement/ Containment/ Control	Confinement/ Containment/ Control
Deciduous Riparian Fire Behavior Predictive Fuel Models 1 and 9	594	25 (149)	Confinement/ Containment/ Control
Oak-juniper-piñon Fire Behavior Predictive Fuel Models 3 and 1	12,323	45 (5,545)	10 (1,232)

1 Fires with low-severity effects refer to stand-maintaining surface or ground fires that burn only along the ground and never reach the tree canopy; such fires only burn the litter, debris and small plants on the surface of the soil but may burn down into the organic material of the upper soil layer. Moderate-severity fires also are stand-maintaining fires, that may reach into the canopy of some trees but do not cause complete mortality of all the trees in the area. Fires with high-severity effects or stand-replacement fires, refer to those fires that kill practically all vegetation within a given "fire" boundary; resulting conditions favor different or pioneer vegetative/structural composition or communities.
2 Percentage of actual area per event.

3.1.6. Prescribed Wildland Fire (prescribed fire)

Prescribed fire may be used in all vegetative types to meet natural resource needs and desired wildland fuel inventories; however, prescribed fire will be deferred in areas containing desertscrub and deciduous riparian vegetative associations. Most prescribed fire will be conducted during the normal fire season beginning in May of each year. Prescribed fire will be managed to meet specific objectives, including the desired acreage and intensity of burns within each fuel type to meet TE species objectives. Therefore, prescribed fire will be conducted when levels of treatment acres are not being met through prescribed fire in FMUs where conservation measures are in place. Some FMUs may be burned during the cool season (October–April) to conserve specific habitat types, to protect facilities or wildlife, and to meet specific habitat management or wildland fuel inventory objectives, such as protecting and stimulating sacaton growth or reducing understory fuels in sensitive riparian areas. Mesquite bosque that contain numerous trees with cavities may also be burned with a cooler fire to protect the potential pygmy-owl habitat from catastrophic wildfire by reducing fine-fuel loading.

Xeroriparian and deciduous riparian areas may be burned during the cool season by low-intensity wildfire for the management of unnaturally high herbaceous wildland fuels or when specific resource values will be enhanced. Cool season wildland fire allows for an increased control of fire intensity, maintenance of buffer strips along the riparian ecotone, and a reduction in the amount of heat to which trees are exposed. Cool season low-intensity wildfire is a safe approach for preserving resource values and gives fire crews greater opportunities to confine, contain, and control. Xeroriparian and deciduous riparian habitats that run through or are adjacent to FMUs designated for prescribed fire prescribed fire will be protected through planning the ignition patterns so that a head fire that will remove canopy cover. Since 2002 the BANWR has utilized this ignition technique that allows fire to creep into deciduous riparian areas but to burn at low

intensity, thus minimizing effects on habitat components. The higher humidity and cooler temperatures in xeroriparian habitats also assist in minimizing fire effects. Although wildland fire can be expected to temporarily reduce or replace certain vegetative components within an area (some deliberately, such as mesquite), fires of appropriate intensity and frequency will assist with regeneration and long-term survival of desired vegetative components. Among these are Pima pineapple cacti and Palmer's agave (a primary food plant for the lesser long-nosed bat, also a protected species). Consequently, to minimize the likelihood of long-term adverse effects of prescribed fire on TE species and to ensure healthy, sustained populations of these species, the AVFMP establishes maximum fire effect thresholds for the planning area. This conservation strategy allows for the integration of wildland fire as a sustaining rangeland management activity, minimizing adverse effects of wildland fire and enhancing habitats for TE species.

3.1.7. Conservation strategies

The AVFMP planning area describes areas that are not appropriate for any wildland fire and where wildland fires are actively suppressed because of public safety concerns within the WUI of local communities, wildland fire management implementation through existing agreements such as the BANWR and Coronado National Forest (CNF), or by the decision of individual ranchers within the planning area to defer and suppress wildland fire. These wildland fire suppression zones will not be identified for management of wildland fire, and therefore, implementation of the AVFMP will not affect TE species or other resource values within the suppression zones or on federal lands where wildland fire is managed through existing agency decisions. The planning area consists of 609,900 acres of wildland habitat. The BANWR consists of 116,542 acres and will be managed under the existing BANWR Fire Management Plan and BO. The CNF consists of 84,742 acres and will be managed under the existing CNF Fire Management Plan and BO. In addition, 125,116 acres have been identified for full suppression of wildland fire.

Therefore, the wildland fire "maximum fire effect threshold" is 283,500 acres, or 46.5 percent of the planning area. The wildland fire maximum fire effect threshold establishes the maximum number of acres that could be planned for prescribed fire for any one year or over a three-year planning period by restricting prescribed fire acreage and fire severity both across the planning area and by vegetation type, which would minimize the likelihood of long-term adverse effects of prescribed fire management on TE species and ensure that healthy, sustained TE species habitats are established as a component of the AVFMP.

Wildland fire management will be limited to the maximum fire effect threshold across the planning area including sensitive species habitats such as Pima pineapple cactus and Palmer's agave. Pima pineapple cactus habitats occur primarily within the Sonoran and semi desert grassland communities and their ecotone, normally between 2,300 and 5,000 feet in elevation. Palmer's agave habitat is also found within these vegetative communities, occurring generally above 3,500 feet in elevation. Wildland fire has been deferred in these vegetative communities (southwest desertscrub) or limited by maximum fire effect thresholds (semi desert shrublands). Cactus ferruginous pygmy-owl habitat

also occurs within the Sonoran semi desert shrublands and desertscrub habitat as well as within the riparian corridors consisting of mature mesquite and other tree species that support cavity-nesting birds. Low-intensity prescribed fire are deferred in deciduous riparian unless needed to manage increases in fine wildland fuel loads; moderate and high-intensity prescribed fire are deferred without exception in these areas. Although wildland fire may creep into xeroriparian riparian areas within some FMUs during prescribed fire, fire ignition patterns and fire management techniques will be employed to minimize effects on riparian and xeroriparian habitat components.

The maximum fire effect threshold of the AVFMP planning area is restricted to 283,500 acres. The AVCA has estimated that no more than a 3-year mean of 15 percent of the maximum fire effect threshold acres would be planned for prescribed fire to obtain ranch rangeland improvement objectives while considering the cost of prescribed fire monitoring as well as pasture restocking. Over the life of the AVFMP, there will certainly be favorable and unfavorable burning periods. During periods of favorable burning conditions, the 3-year mean maximum fire effect threshold provides flexibility for several ranches to conduct planned prescribed fire burns while ensuring that potential negative effects of prescribed fire to specific TE species and other habitat effects are minimized. As outlined in Table 4.3, no more than 45 percent (127,350 acres) of the maximum threshold acres would be burned over a 3-year period and no vegetative association maximum fire effect threshold would be exceed. During planning periods consisting of multiple years of favorable burning conditions, 15 percent of the maximum fire effect threshold acres (42,525 acres) would be planned each year for prescribed fire. During a 3-year planning period, however, acres identified for prescribed fire may vary within the vegetation association constraints and within the 3-year mean constraints of the maximum fire effect threshold acres. Therefore, if 45 percent of available acres are treated by moderate or high-intensity prescribed fire during a single year, no prescribed fire would be planned for the next two years, and all wildland fires would be controlled for the next two consecutive years. Additionally, if a single vegetative association is treated by moderate or high-intensity prescribed fire during a single year, no additional prescribed fire will be planned for that vegetative type, and wildland fires will be controlled for the next two consecutive years.

In addition to the above strategies, acreages burned by prescribed fire and acreages burned by prescribed fire are additive with respect to the maximum fire effect threshold as described in Table 3. All wildland fire will be suppressed when threshold limits have been met. Prescribed fire will not be conducted when the described threshold specific FMU fire and resource management objectives have been met. Also habitat acreages burned by prescribed fire in excess of acres that are suppressed by fire responding agencies or departments will also apply to the acreage burn limits described in Table 3

1. Wildland Fire Implementation Plan:

Before implementing prescribed fire in the planning area, which includes private, county, or state-trust ranchlands, the individual or agency initiating the use of fire will work together with the AVFMP collaborative group to prepare a WFIP in accordance with applicable federal, state, and local requirements.

2. Wildland Fire Management and incorporation of conservation measures:
Before implementing wildland fire management on private or state-trust ranchlands of any participating rancher, the affected participating rancher, AVCA, ASLD, NRCS, and USFWS, as appropriate, will ensure that all applicable conservation measures described in Section 5.C, as well as any additional conservation strategies or conservation measures recommended in the BO by the FWS, are incorporated into the burn plan.

Any participating rancher who requests that prescribed fire be permitted within a specific FMU—assuming all conservation measures are in place—should understand that approval of that prescribed fire plan will be subject to acres burned by subsequent prescribed fire or suppressed wildland fire. Depending on the acreages actually burned by prescribed fire and wildland fire, the prescribed fire may need to be postponed or reduced in size to ensure that the AVFMP's maximum fire effect threshold acres are not exceeded. Conversely, wildland fire occurring within a specific FMU after fuel and natural resource management objectives have been met by prescribed fire may need to be suppressed.

The attainment of these acreage levels will principally result from "natural" phenomena. prescribed fire burns will create a mosaic of localized intensities. Although stand-maintenance fires may be achieved by both low and moderate fire intensities, a mosaic pattern of cover and vegetation over the landscape are preferred, and small-scale, localized vegetation type conversions may occur as an element of prescribed fire events conducted under moderate and high-intensity burn levels. Habitat components normally will not be altered from low-intensity fires other than single-season reduction in fine fuels (i.e., 1-hour to 10-hour fuels). Low-intensity prescribed fire, when implemented properly, will also produce a sporadic burn pattern so that not all fine fuels in any one prescribed fire will be affected.

3.2. Fire Management Units (FMUs)

The AVCA developed the Fire Management Unit Map (FMUM) of the Altar Valley watershed-depicting areas of confinement, containment, or control for wildland fire as well as water tanks, wells, fences, and vegetation transects that may provide access for emergency resource response for wildland fire suppression. The AVFMP evaluated and where necessary, for wildland fuel and natural resource benefit, realigned or reconfigured FMUs to meet fire response needs through natural or man-made barriers to wildfire movement. The BANWR has described and mapped the refuge FMUs that are reflected in the AVFMP. The AVFMP was drafted to meet fire management planning requirements of the land management agencies and private landowners through the use of applied geographical information system (GIS) analysis. The AVFMP describes 158 FMUs within the planning area by associated livestock allotments or land-use designation (Figure 3).

From GIS analysis, it was evident that the various ecological elements (e.g., vegetative cover) were not randomly distributed throughout the AVFMP analysis area. Analysis of

the various ecological components revealed grouping or clumping of features. The development of these FMUs is based on general environmental considerations such as vegetation type, fuel loading, and specific TE wildlife habitat considerations. Specific wildlife habitat parameters analyzed include actual and potential Pima pineapple cactus (*Coryphantha scheeri* var. *robustispina*) habitat (Figure 5) and potential cactus ferruginous pygmy owl habitat (*Glaucidium brasilianum cactorum*)(Figure 6). Finally, the FMUs were overlaid on the wildfire potential map to identify areas at higher risk for wildland fire (Figure 7). Refer to Appendix A for a more detailed display of the analysis criteria that were considered in the development of the delineated FMUs.

From the analysis, the 158 FMUs range in size from 2 acres to 22,897 acres. Wherever possible, roads and drainage boundaries were used as logical divisions between the FMUs. Since some watersheds contain sensitive vegetation communities they were also included as criteria in the FMU development and analysis process. Each FMU is primarily composed of one of the major vegetative-cover types present. However, since desert grassland and mesquite habitats are the two most common vegetative types, usually one or both of these are abundant in other vegetative-type classifications. For example, desert grassland vegetation type was a codominant form in many FMUs.

From a TE standpoint, several FMUs are less-sensitive areas composed of few xeroriparian, riparian, or desert scrub vegetation types, while many are more complex because of the presence of sensitive habitats. Consequently, management of fires within the boundaries of the respective FMUs will be variable within and between FMUs. Fires within similar sensitive FMUs may still be managed differently because of the range of preferred habitat, structural features, or community values.

3.3. Vegetation Types and Objectives

Individual burn blocks will have criteria for grazing deferment during the growing season following treatment. Each site will be assessed as to length of rest based on several factors including precipitation, burn intensity, and post fire herbaceous production.

3.3.1. Vegetation Types

Nonnative or Lehmann grassland

This vegetation association is dominated by Lehmann lovegrass. This association occurs primarily on uplands characterized by shallow soils. Small mesquites (less than or equal to 15 years of age) are distributed throughout the association with canopy cover less than 10 percent. Young mesquites may be increasing and showing above the grass. Lehmann lovegrass is a very prolific seed producer and is drought and fire tolerant. However, Ruyle et al. (1988) note “The increase in germinability of Lehmann lovegrass seeds associated with fire may be one of several factors important in its observed ability to re-establish after mature plants are killed by burning.” Rogers (2004) states, “Regardless of the time of year Lehmann lovegrass was burned, the grass grew back and, in some cases, increased in amount.” Early spring burns have been used to maintain the integrity of

established native grasses with a desire to stimulate increases in densities and frequencies of native grasses. This association lends itself to more frequent fire re-entry every two years (two growing seasons), and some units could be burned as soon as fine-fuel loadings are adequate to carry a fire of moderate to high intensity. This association lends itself to more frequent fire re-entry (two growing seasons), and some units could be burned as soon as fine-fuel loadings are adequate to carry a fire of moderate to high intensity. It generally takes 3 – 5 years after a to build up adequate fine-fuel loadings to carry moderate to high intensity fires. Fires could be ignited on burn units on a 3-to-5-year cycle to maintain low mesquite densities and enhance native grass establishment.

Johnson Grass/Sacaton/Russian thistle

The Johnson grass/Sacaton/Russian thistle (*Sorghum halapense*/*Sporobolus* spp./*Salsola kali*) association grasslands occur mostly on the deeper soils adjacent to wash basins and drainages. A few woody species, such as mesquite, catclaw (*Acacia greggii*), and desert willow (*Chilopsis linearis*), occur within this association, though few native grass species are present. Small patches of this association provide good cover for masked bobwhite, and both Johnson grass and Russian thistle seeds provide potentially important winter food. However, large expanses of Johnson grass and Russian thistle provide poor habitat for masked bobwhite (*Colinus virginianus ridgewayi*). This association has dominated areas adjacent to the large washes for more than a decade. These areas could be improved by simply encouraging the reestablishment of native grasses. Fine fuel loads are extremely high for this vegetation type. Since very hot fires are anticipated, woody plant invasions should be effectively suppressed in this vegetation association. Fire intensities are quite variable within this association as only Johnson grass and sacaton stands carry hot, high intensity fires. Many of these areas are dominated by pigweed, which does not generally carry hot fires. Early spring (February-March) burns, with adequate soil moisture (2” – 4” of precipitation during January and February), are used to maintain and enhance sacaton stands. Early summer (May-June) hot burns run a risk of seriously reducing stand densities of sacaton due to heavy accumulations of fine, dead fuels around the crowns of the plants.

Native grass

Native grass associations are composed predominantly of native perennial grass species with less than 10 percent shrub cover. Early spring burns leave the soil exposed and subject to erosion for long periods of time. This may also increase the possibility of invasion by lovegrass as it germinates much earlier than most native grasses (March-April vs. July-August). However, hotter burns in early summer are favored because cool burns have little effect on mesquites, which can cause the mesquite canopy to increase in native grass associations. This association presents a challenge, because these sites tend to be located on shallower upland sites that, in many cases, do not produce adequate vegetative biomass to carry hot fires. This makes mesquite control very difficult, and other mesquite control methods need to be explored to maintain the integrity of these communities.

Lehmann lovegrass/native grass mix

The Lehmann lovegrass and native grass grassland associations consist of a mixture of Lehmann lovegrass (35–65 percent) and native grasses (65–35 percent), with mesquite and desert shrubs distributed throughout (10–35 percent total shrub cover and less than 15 percent mesquite canopy cover and increasing). Lehmann and native grass associations represent a transition from a native species to introduced exotic species and occur adjacent to the major washes and drainages. Grass is the fire carrier in this vegetative type with down and dead fuels, shrubs, and trees adding very little to the fire behavior. In this situation mesquites act more as a heat sink, retarding fire behavior rather than adding to it. The heavy fuels present are generally not consumed during fires. Many trees are top-killed but do not function as available fuel. Flame lengths range from 5 to10 feet, depending on the fine-fuel loading. Fire is particularly effective in reducing lovegrass densities following dry winters, although this can be a fine line as natives are more heavily affected during dry years. Winter rains tend to favor Lehmann lovegrass with good monsoons favoring natives. Hot fires are recommended on a 3 to10-year rotation depending on growing conditions and grazing pressure in an attempt to reduce mesquite encroachment and stimulate native grass establishment.

3.3.2. Mesquite Associations

Mesquite and Lehmann lovegrass

A mixture of mesquite and Lehmann lovegrass characterizes this Type F grassland vegetation association (Gori and Enquist 2003). Fuel models 1 and 3, depending on the fine-fuel loading, again represent this vegetative association. Typically, the level of mesquite canopy with Lehmann's understory will fall into fuel model 3. If the understory mix is a mostly native, the vegetative type will fall into fuel model 1. Mesquite is distributed within a matrix of Lehmann lovegrass and native grasses. However the foliage in this vegetation type is not highly flammable, and dead woody material does not significantly contribute to the fire intensity. Mesquite canopy cover ranges between 5 and 20 percent. Prescribed fire could be used to reduce mesquite density and canopy cover as well as Lehmann lovegrass density and distribution, to expedite native grass recovery, and to improve native habitat components. The management regime would consist of hot fires planned on a 3 to10-year cycle. Hot fires could be ignited on burn units 3-5 growing seasons after an initial high-intensity fire if preliminary transect data indicates that this fire regime will favor native grasses.

Mesquite

This Type F grassland association (Gori and Enquist 2003) is dominated by mature mesquite (greater than or equal to 30-years-old) and is restricted to the deeper soils adjacent to xeroriparian areas. Canopy cover over most of the association exceeds 80 percent and often approaches 100 percent. The extensive shading typified by this plant association creates microclimatic conditions that are not conducive to herbaceous production under the mesquite canopy. Fine-fuel biomass is therefore generally low

throughout this association. Heavy-fuel accumulations are also discontinuous, occurring wherever openings in the canopy permit sufficient sunlight for heavy forb and grass production. Because of insufficient fine-fuel accumulation (less than 800 lbs/acre) evident in most of these mesquite-dominated associations, it would be difficult to ignite or maintain a prescribed fire. It would be necessary to permit fine fuels to accumulate for several years before a management burn could be successfully achieved. Within upland habitats, mechanical management practices may have to be implemented to reduce canopy cover to allow for increased ground fuels before prescribed fire could be considered. Although wildland fire may be allowed to creep through xeroriparian habitats, these areas, which are dominated by mature mesquite, provide possible habitat for the cactus ferruginous pygmy- owl; therefore prescribed fire is typically deferred.

3.3.3. Desertscrub Associations

Semi desert scrubland

The semi desert scrub/grass Type B or E grasslands mix (Gori and Enquist 2003) occurs primarily on uplands and is composed of a mixture of snakeweed, burro brush, creosote bush, half shrubs (35–65 percent) and grass (65–35 percent). The grass component may consist of natives, Lehmann lovegrass, or buffel grass (*Pennisetum cilare*) an invasive nonnative that is spreading into Sonoran desert habitats. Stands of sub shrubs are difficult to burn because of insufficient fine-fuel loads within a stand. Generally this vegetative type is classified within fuel model 1. Hot fires appear to cause high mortality among sub shrubs. Wildland fire of this intensity (representative of fuel model 1) usually occurs only in years of above-average precipitation, which produces an abundance of annual vegetation. Consequently, late spring and early summer fires hold great potential for rehabilitating large acreages that are threatened by sub shrub invasion. Semi desert scrub associations could be exposed to hot fires on long-return intervals, when fine-fuel loads reach 800 lbs per acre or more. A shorter fire return cycle is not feasible because fine fuel would probably not accumulate in sufficient amounts to carry a fire under a 2 to 8-year regime.

Southwest desertscrub

Southwest desertscrub vegetative associations including saguaro (*Carnegiea gigantea*), palo verde, mesquite, ironwood (*Olneya tesota*), mixed scrub, and cacti, occur primarily on uplands and are composed of little herbaceous vegetation and scattered desert scrub areas. This vegetative association is typically not suitable for prescribed fire. Wildland fire typically does not play a role in the maintenance of this ecosystem and fire-return intervals are very long. Prescribed fire therefore should be deferred in desertscrub management units. Prescribed fire would be very rare and individually reviewed for meeting vegetative type objectives.

3.3.4. Riparian Associations

Deciduous riparian

The nature and species composition of riparian vegetative associations change depending on elevation and adjacent upland vegetation. Lower elevations within the AVFMP consist of xeroriparian species, while higher elevations consist of deciduous riparian species with steeper stream gradients. Typical xeroriparian species include mesquite, sandbar willow (Sal*ix interior*), seep willow (*Baccharis glutinosa*), desert broom (*B. sarothroides*), hackberry (*Celtis pallida*). Higher-elevation deciduous riparian vegetation association species include maple (*Acer* spp.), Goodding willow (*S. gooddingii*), velvet ash (*Fraxinus velutina*), elder (*Sambucus* sp.), sycamore, walnut (*Juglans* sp.), and cottonwood. Fire is spread mostly through fine fuels consisting of annual weedy litter with clumps of heavier fuels associated with the riparian corridor. Perennial grasses may be limited because of an overstory of riparian shrubs and trees. Ladder fuels consisting of desert and semi desert scrub species may be present in higher-elevation riparian corridors. This association is extremely variable due to a wide range of fuel loadings based on canopy cover and species present. This vegetative community can include fuel models 1, 2, 3, and 9 and, in extreme cases, at higher elevations with manzanita (*Arctostaphylos* spp.) in the understory, may approach fuel model 4 (Appendix A). The mesquite and deciduous riparian falls mainly into fuel model 1 with some areas within fuel model 2 and fuel model 3 depending on fine-fuels. Areas dominated by cottonwood, willow, and sycamore would normally be considered within fuel model 9. Cool season or low-intensity fires may be recommended for wildland fuel management when fine fuels are present at 800 lbs per acre or greater.

3.3.5. Oak-juniper-piñon Association

Oak woodland and oak-juniper-piñon

The oak-juniper-piñon woodland is normally present at elevations above 4,000 feet, including steep slopes within the major mountain areas. The plant community is dominated by evergreen oak species, junipers, and scattered piñon pines (*Pinus cembroides*). The major vegetation association includes a mix of cool and warm season grasses, forbs, and succulents. Canopy cover can range from less than 20 percent to greater than 50 percent. Additional upland scrub species include semi desert vegetation, such as catclaw, mimosa (*Mimosa biuncifera*), ocotillo (*Fouquieria splendens*), kidneywood (*Eysenhardtia orthocarpa*) with grass species such as sideoats grama (*Bouteloua curtipendula*), cane beardgrass (*Bothriochloa barbinodis*), and plains lovegrass (*E. intermedia*). Oak woodlands consist of open areas with scatted groupings of heavier fuels. Open canopies, light grass, and ground (surface) fuels normally result in flame lengths of 4 feet or less, preventing crowning or overstory burns. Depending on density of trees, slopes, and ground fuels, some stand-replacement, high-intensity burns are achieved in clumps of heavier fuels where continuous ladders are present from abundant ground fuels and continuous ladder fuels into the overstory in association with dead woody material within the crowns. Natural fire return intervals are estimated at 50–100 years with stand replacement fires occurring every 300 years or more. Cool season burns for fuel mitigation may be conducted when fine ground fuels reach an average of 800 lbs/acre or greater. Many of these areas within the Altar Valley are currently set up

for stand replacement fires. Fine-fuel loadings of grass and scrub species are currently very high in the 1500 – 3000 lb/acre category. Flame lengths will be in the 5 – 20 foot range.

3.4. Community Suppression Values

Valued resources potentially at-risk include structures, communication facilities, power lines, recreation areas, cultural or historic areas, sensitive wildlife habitat, grazing improvements, and natural resources. These values have a negative influence on the potential of an area to sustain or to be planned for wildland fire management.

Developed land and infrastructure were given the highest value in the AVFMP area for suppression activities. Recreation areas including campgrounds, parks and trail systems, and sensitive wildlife habitats were given a moderate value.

1. Housing, Essential Infrastructure, and Suppression Areas

The cooperating agencies have identified areas for conditional wildfire suppression, including the major transportation corridors within the Altar Valley—SR 86 and SR 286. Transportation corridors between communities that serve as suppression-response corridors in the event of wildland fire or that are located within suppression areas have also been identified. Structures associated with housing and commercial developments located in subdivisions and in more dispersed areas of the Altar Valley are also identified for aggressive suppression. The cooperating agencies have delineated infrastructures such as power lines, communication facilities, rangeland improvements, and suppression corridors and have recommended fuel-modification treatments that will reduce the threat of wildland fire affecting these facilities. A Community Wildfire Protection Plans (CWPP) has been developed for the communities of Sasabe and Arivaca.

2. Wildlife Species and Habitat

The Altar Valley watershed supports a wide variety of animals common to the Southwest desert. Among these are mule (*Odocoileus hemionus crooki*) and white-tailed (*O. virginianus*) deer: Mule deer range throughout the Altar Valley watershed with white-tailed deer found in the higher elevations of the San Luis, Las Guijas, and Baboquivari mountains. Pronghorn antelope (*Antilocarpa americana sonoriensis*) have been reintroduced within the Altar Valley watershed, a part of their historical range. Many species of small mammals, reptiles, and birds are found within the planning area. The BANWR has an outstanding variety of bird life, with 289 species of documented birds including four species of quail, as well as mourning (*Zenaida macroura*) and white-winged (*Z. asiatica*) doves. Many year-round resident, winter-migrant, and summer-resident raptors are found in the Altar Valley. Existing ponds also attract waterfowl, shore, and wading birds during winter and fall migrations.

The cooperating agencies have determined that reintroducing wildland fire within prescribed limits benefits watersheds and wildlife within the Altar Valley. Prescribed fire

management will lessen the threat of catastrophic wildland fire in riparian corridors, will lower the loss of mature nesting trees, will enhance native grasslands that preserve sensitive habitats and wildlife species, and will protect recreational values and livestock grazing uses.

The proposed fuel treatments recommended within the AVFMP may potentially affect Act-listed species. Therefore, consultation with the FWS will be required, and because of Federal actions necessary to implement the recommendations of the AVFMP, a NEPA analysis will be necessary. All potential occurrence sites and effects of the recommendations of the AVFMP are not fully known for these species within the planning area; therefore, consultation with the FWS will need to be conducted for a determination of specific project-related effects on these species. Additionally, any treatments in these species' habitat areas may require further analysis in accordance with Federal and State regulations. Measures to minimize the effects on sensitive species are recommended in the AVFMP analysis. The cooperating agencies, with the NRCS as the lead agency for FWS consultation, will initiate formal consultation with the FWS under a Programmatic Consultation process to be completed by the NRCS in 2007.

Conservation measures are part of the proposed action and are included in the FMP to reduce potential impacts of prescribed and wildland fire on species listed under the Act. These conservation measures will be evaluated as part of the FMP during section 7 consultation with FWS on the AVFMP. Additional evaluation and consultation may be required if project boundary or treatment recommendations are not consistent with proposals outlined in the project's NEPA document.

3. Watersheds

The AVFMP planning area includes several significant watersheds including both federal and nonfederal lands, including the Brawley Wash–Los Robles Wash, Rio Concepción, San Simon Wash, and a small portion of the Aquirre Wash–Tat Mormoli Wash. Most of the watersheds in the AVFMP are located on state trust lands and are at some risk of mesquite and invasive species encroachment.

Prescribed fire will enhance ground cover, decrease erosion and enhance percolation abilities of the watersheds and will affect the water supply downstream of each watershed. The reintroduction of prescribed fire to the Altar Valley will begin to restore a healthy watershed that can provide many positive attributes. These include enhanced water quality, diverse aquatic and wildlife species, and vegetation that protects the soil and prevents erosion. Good stewardship activities can help maintain and enhance a healthy watershed, restore an unhealthy one, and lower the risk of habitat degradation from the encroachment of brush and exotic vegetative species.

3.5. Endangered Species Considerations

Until recently, range improvement measures had routinely been implemented in the Altar Valley to maintain ecosystem health. Beginning in the early 1990s, those practices began

to conflict with ESA considerations (e.g., the listing of the Pima pineapple cactus and cactus ferruginous pygmy-owl as endangered species in 1993 and 1997, respectively) that ultimately resulted in a reduction in the application of these practices. The AVFMP is needed not only to enable Altar Valley land managers and ranchers to resume wildland fire management practices, but to ensure that such practices do not impede the simultaneous goal of recovering and protecting federally listed species.

Verified sightings of TE species in recent years include the Pima pineapple cactus (*Coryphantha scheeri* var. *robustispina*), Kearney blue star (*Amsonia kearneyana*), bald eagle (*Haliaeetus leucocephalus*), masked bobwhite, southwestern willow flycatcher (*Empidonax traillii extimus*), Mexican spotted owl (*Strix occidentalis lucida*), lesser long-nosed bat (*Leptonycteris curasoae yerbabuenae*), Chiricahua leopard frog (*Rana chiricahuensis*), and jaguar (*Panthera onca*). A Biological Assessment (BA) was completed to assess the impacts the AVFMP implementation may have on TE species. The BA addresses species protected under the ESA that may be affected by implementation of the AVFMP (Appendix C).

3.5.1. Pima pineapple cactus conservation measures:

Pima pineapple cactus is a small spherical cactus that is found in Sonoran desert scrub and grassland vegetation communities in the Altar and Santa Cruz River Valley. Suitable Pima pineapple cactus is defined as:

- Those habitats within the action area that are between 700 m and 1,400 m (2,300 – 4,500 ft) in elevation that are in the following vegetation types:
    - Semi-arid grasslands
    - Desert scrub

Soils associated with PPC populations on the BANWR are congruent with areas in the planning area.

The fire tolerance of the species has not been documented but given that it is associated with native grassland habitats that are subject to periodic fire, some level of fire adaptation may be inherent in the species. The original listing states: “The Fish an Wildlife Service (Service) presumes the Pima pineapple cactus, a resident of fire-adapted semidesert grasslands, has evolved with fire, but it is unknown what circumstances and strategies allow the species to survive fire” (FR58, No. 183, p.49875). “The assumption that a decreased fire frequency or not burning at all benefits the Pima pineapple cactus and its ecosystem presumes that fire is detrimental to the species and ecosystem. The Service has no data to support this assumption” (FR58, No. 183, p.49877). Data from the BANWR burn program will provide some baseline information regarding this factor. A more complete description of this species life history and biology is included in the associated BA. The following are the conservation measures that are part of the proposed fire management plan.

Prescribed fire plans developed for areas without suitable Pima pineapple cactus habitat – as described above, do not require conservation measures.

Prescribed fire plans developed for areas that include suitable Pima pineapple cactus habitat will include the following:

- Single pass surveys to locate individual cactus will be performed over the suitable Pima pineapple cactus habitat within the boundaries of the proposed burn.
    - Suitable habitat will be determined by elevation and habitat type. If developed, a Pima pineapple cactus habitat model similar to the model used by the Buenos Aires National Wildlife Refuge will be used to determine suitable habitat.
    - Surveys are valid for a maximum of 6 years.
- Individual cactus will be protected from the effects of the prescribed fire.
    - This will be accomplished through the clearing of fuels from around individual cactus from the area between 2 to 3 m from the plant, leaving the vegetation within the 2 m radius immediately surrounding the plant untouched. Alternatively, a fire-proof, cone-like structure may be used to protect each plant.
    - An area with a high density of cacti or a group of cacti may be protected through blacklining a similar area around the cacti.
- Post fire census of the known cactus to determine effectiveness of protective measures will also be made.
    - This should occur within 30-60 days after the fire and again within 120 days.
- The acreage of each fire will be reported as will the location of cactus, protective measures used, and their effectiveness in protecting individual cactus. This information will be used to determine the short-term vs. the long-term effects of the FMP.

Exceptions to these basic conservation measure are possible as part of a quantitative research study of fire within various fuel loads and types on Pima pineapple cactus approved by the Service. This study should include:

- Single pass surveys to locate individual cactus shall be performed as part of the study.
- No protective measures will be required for individual cactus within the study related burns up to a maximum of 20% of the individuals in the burn perimeter.
- Prescription parameters, fuel types, fuel loads, fire behavior, and fire severity should be part of the information to determine the fire effects on individual cactus and potentially the population as a whole.
- Post fire surveys to determine the fire effects on individual cactus within 30-days of the fire, within 6 months of the fire, and approximately 1 year after the fire. This schedule may be modified to fit approved research design.
- The results will be used to evaluate the basic conservation measures listed above. Modifications to the conservation measures will be proposed based upon these results and modifications to the FMP may be made if applicable.

Prescribed burns on the Pima pineapple cactus mitigation bank will need to be consistent with the mitigation bank agreement.

3.5.2. Masked bobwhite conservation measures:

- Seasonal restriction if birds are present.
- Aerial ignition patterns should be not have flame fronts ignited closer than ¼ mile apart to allow for escape routes and a more natural, mosaic-burn pattern, with exceptions for firefighter safety, personal property, or other resource protection measures.

3.5.3. Lesser long-nosed bat conservation measures:

- Prescribed burns will not include areas where smoke could affect roosts while bats are present.
- Ignition patterns should avoid high severity fire effects in Agave patches

3.5.4. Chiricahua leopard frog conservation measures:

- Avoid high severity fire effects upstream from any occupied habitat
- If extensive erosion is possible, sediment traps should be placed above occupied habitat to reduce potential take of this species.

3.5.5. Kearney's bluestar conservation measures:

- Avoid known populations

3.5.6. Southwest willow flycatcher conservation measures:

- Mesoriparian woodlands are not a common habitat feature in the action area and will not be included in any prescribe burn plans.

3.5.7. Mexican spotted owl conservation measures:

Prescribed Burns that are planned to include suitable habitat of the Mexican spotted owl will have surveys conducted, per established Mexican spotted owl survey protocol (FWS 2003) as amended, to determine occupancy of the habitat within and adjacent to the burn perimeter.

If occupancy can't be demonstrated the burn may progress as planned.

If occupancy is demonstrated, the burn will be implemented:

- Outside the Mexican spotted owl breeding season March 1 through August 31.

If occupancy is demonstrated and the burn is planned during September 1 through February 28, the burn will be implemented:

- So that the nest cores are left undisturbed, approximately 100 acres around the nest, or
- Fire and fire management activities will remain more than a ¼ mile away from the next.

Candidate Species:

3.5.8. Western yellow-billed cuckoo (*Coccyzus americanus*) conservation measures:

- Mesoriparian woodlands are not a common habitat feature in the action area and will not be included in any prescribe burn plans.

3.6. Management and Oversight

The NRCS has agreed to initiate Section 7 consultation, as the lead federal agency, on the potential effects of the AVFMP on listed and proposed species. The NRCS has also agreed to assist with the coordination and application of prescribed fire as the plan is implemented and to assist, as time permits, with the implementation of the monitoring requirements. The NRCS has accepted the lead role in coordinating annual burn plans among the cooperating agencies and AVCA members. The NRCS will produce an annual burn plan report consisting of a "current year burn map" that NRCS will provide to the FWS for review and comment. In cooperation with the FWS, the annual burn plan and map may be revised to meet TE requirements depending on the status of conservation measures, a review of the previous year's prescribed fire objectives, current and predicted wildfire season, and any new information or amendments to the AVFMP that will be applicable during the planned prescribed fire period. The cooperating agencies will review the annual report, determine the desired prescribed fire application that will meet the AVFMP objectives, and provide this information to the NRCS by December 31 of each year. The annual monitoring report will include a list and map of areas approved for prescribed fire. Additionally, the report will include proposed new or revised conservation measures or amendments to the AVFMP that were adopted by the cooperating agencies and participating private landowners. Changes to the AVFMP will be based on monitoring data from the previous year or independent research reviewed and accepted by the cooperating agencies and participating private landowners.

3.6.1. Access Agreements

Subject to the restrictions below, participating ranchers and ASLD will grant access to their lands to the cooperating agencies and their designated agents or contractors for the purpose of conducting monitoring activities and studies specified by the AVFMP. Any legitimate scientific research on the covered species and any surveys for the covered species not otherwise specified by the AVFMP which the cooperating agencies wish to

carry out, are also part of the agreement. No entry onto private ranchlands within the AVFMP area to conduct these activities may occur without a written or verbal request to the rancher at least 10 days prior to any such entry or the rancher's permission, which may include additional circumstances or conditions specified by the rancher. The reasons for access and the locations visited on the ranch, unless otherwise permitted by the rancher, are restricted to those necessary to carry out specific monitoring, research, and survey activities that are either required by or specifically identified in the AVFMP. Participating ranchers will grant access for monitoring, survey, and research activities unless they express a specific concern or objection to an individual or organizations entry. In that event, the rancher will explain to the cooperating agencies in writing within 7 days of the receipt of a request for access, the reasons of concern or refusal to grant entry to the cooperating agency to the private ranchlands. Upon receipt of any such notice, the cooperating agencies will work with the ranchers to resolve the issue. No participating landowner can be compelled under the AVFMP to grant access to private lands. If access for monitoring purposes or conservation measure compliance is postponed or denied, planned or future prescribed fire will not be implemented within FMUs on the ranch or ranches controlled by the individuals who have not met their monitoring and/or conservation measures obligations under the AVFMP. Monitoring programs conducted on Pima County, state-trust, or Federal lands require notification of the land managing agency and obtaining necessary permits and agency requirements. Monitoring and conservation measure information gathered on private or state-trust lands within the AVFMP analysis area will be made available to the participating landowner and cooperating agencies and will be contained within annual performance reporting.

Coordination of the monitoring program is assigned to the NRCS; however, the cooperating agencies will work together to assist in finding funding and supporting the AVFMP monitoring program and will participate in carrying out specific monitoring program activities in association with specific burns. Given that monitoring funds and resources may be limited, first priority under the program will be given to TE species conservation measures related to AVFMP implementation; followed by wildland fuel and vegetative objectives.

3.6.2. Local Preparedness and Protection Capability

A principle component of the AVFMP is the emphasis the cooperating agencies have placed on coordination in systematically reestablishing fire on the landscape. The AVFMP follows the policies and procedures of the cooperating agencies and private landowners; however the AVFMP does not make decisions. It provides the operational parameters for fire and land managers to implement the goals and objectives of the cooperating agencies and private landowners within the Altar Valley. Wildland fire response is provided by the ASLD, CNF, BLM, and BANWR. The Three Points and Arivaca Volunteer Fire departments provide response to structural fires within their communities and support for wildland fire response. There is no structural fire response within the community of Sasabe. The large number of private structures adjacent to the BANWR in the Arivaca area, coupled with the distance from the BANWR headquarters, makes wildfire response problematic in this area. The Arivaca Volunteer Fire Department

has been designated as an Initial Attack Department under the Joint Powers Agreement with the State of Arizona to provide first response if a fire occurs on any BANWR tracts around Arivaca and Sasabe.

3.7. Monitoring

Monitoring involves the repeated measurements of variables over time to determine if actions have caused either expected or unexpected changes or trends. As opposed to causal observation, monitoring is designed to assist cooperating agencies in identifying what changes are occurring because of project implementation and whether these changes are due to the action of the project. Monitoring is essential to evaluate the progress towards the AVFMP goals. Monitoring also allows for a clear accounting of effects (both adverse and beneficial) and the actions mitigating negative effects and meeting conservation goals. To develop adequate information to validate assumptions of the major AVFMP goals—in particular, effects on TE species—detailed monitoring data will be imperative. For example, Pima pineapple cactus has historically co-existed with natural wildland fire in the landscape. The long-term effects of prescribed fire under specified intensities over the planning area, however, have not been documented by published research. As a result, the total effects of the methods, timing, and extent of habitat exposed to prescribed fire must be systematically monitored for the cooperating agencies to make informed decisions for future modifications to the AVFMP. The determination of obtaining long-term natural resource management goals often follows an adaptive management (AM) approach, which is a resource management approach that combines science and practical experience by treating management actions as experiments. AM involves careful observations of the ecological systems' responses to management actions and adjusting future management based on what is learned. This allows frequent review and feedback on progress toward reaching project goals while the project is being implemented (USDA 2004a). AM also ensures communication between cooperating agencies (USDA 2003). This collaborative communication allows project managers to take corrective action when faced with changing ecological, economic, or social conditions. Additionally important to ecosystem restoration, this collaborative communication effort helps to assist habitat managers and practitioners in recognizing how implemented treatments change habitats and how future treatments can be modified to meet project goals. It also aids managers in determining the effects of treatments and the effectiveness of the conservation measures. The cooperating agencies have developed an AM monitoring program to determine if AVFMP goals are being accomplished. Effective monitoring is an essential element of AM, because it provides reliable feedback on the effects of project actions.

2. Monitoring Prescribed Fire

Fire-effects monitoring as a visual measure of fire impacts to TE habitat will be accomplished by mapping conducted by the cooperators. Burned-area mapping may be effectively conducted from the ground for prescribed fire. Generally, fire effects are mapped at 500 to 1,500 above ground level on 1:24,000 scale topographic maps. An appropriate level of ground-truthing and sampling will occur to determine accuracy of

fire-boundary delineations. Fire effects will be mapped as follows:

Fire acreage information will be forwarded by the cooperating agencies to the NRCS by December 31 each year for inclusion in the Annual Monitoring Report.

3. Vegetation Surveys

Pace frequency transects will be read by NRCS with the cooperating ranchers on 1 to 3 year intervals, as needed. These data will be used to measure change in plant composition.

3.8. Annual Fire Monitoring Report

Fire occurrence information will be gathered/summarized by NRCS in the fall of each year (Nov/Dec). All participating Ranchers/Agencies will assist with the information gathering and summarizing for an annual report. This report will detail: acres, location, severity of burn, description of burn, any note-worthy comments about burn, etc. Topographic base maps at 1:24,000 scale will be used.

Adaptive Management strategies may be developed or suggested depending on the fire effects on Pima Pineapple Cactus and other TE species, and/or their habitats or habitat components.

In addition to fire occurrence information, pace frequency monitoring information will be maintained by NRCS and available for developing annual prescribed fire planning.

3.8.1 Reporting Timetable

The Annual Fire Monitoring Report will be completed about January 15 of each year.

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APPENDICES

- **A. Figures**
- **B. Fire Regimes, Condition Classes, and Fuels Models**
- **C. Biological Assessment**

Appendix A

Figures

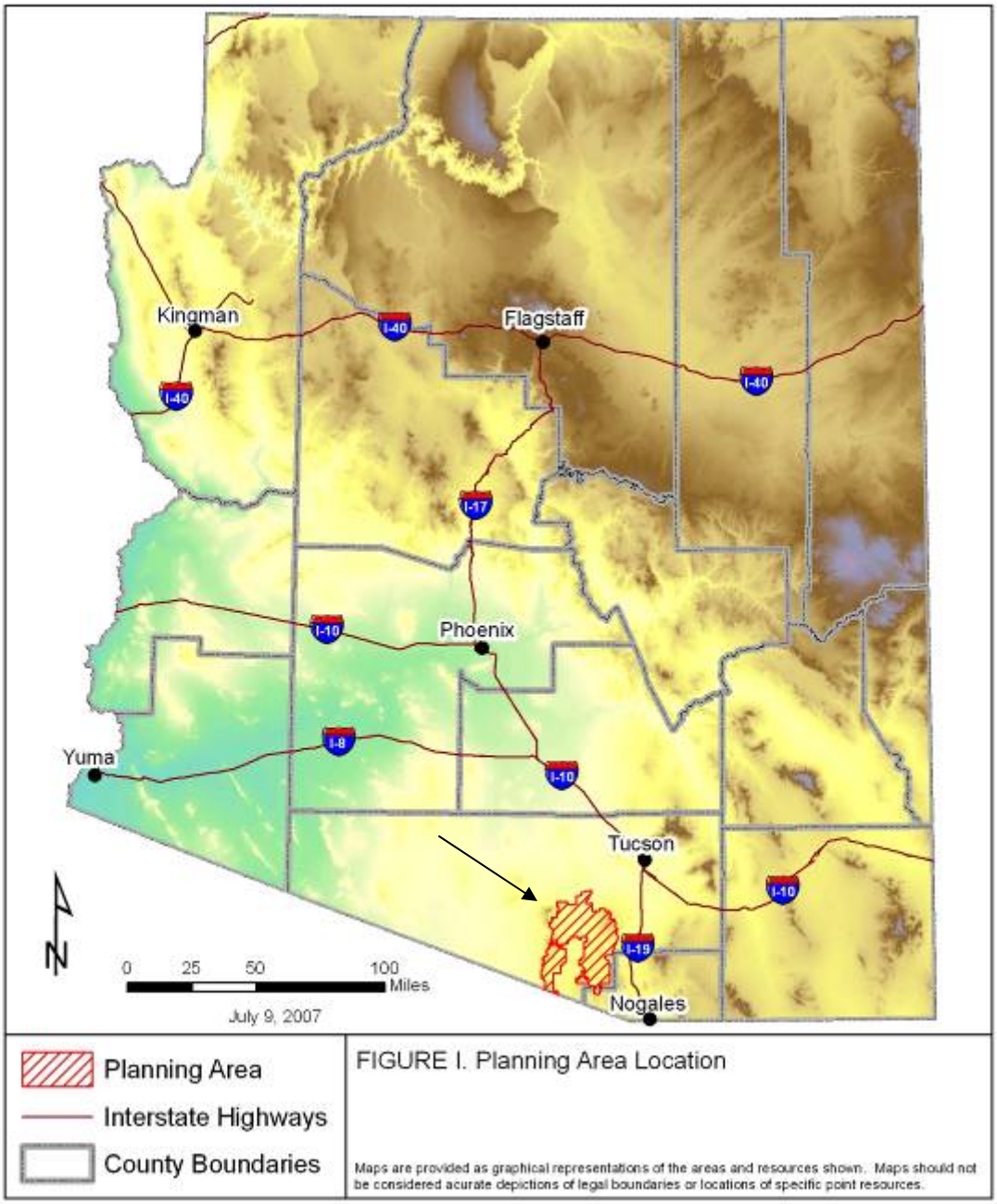


FIGURE I. Planning Area Location

Maps are provided as graphical representations of the areas and resources shown. Maps should not be considered acurate depictions of legal boundaries or locations of specific point resources.

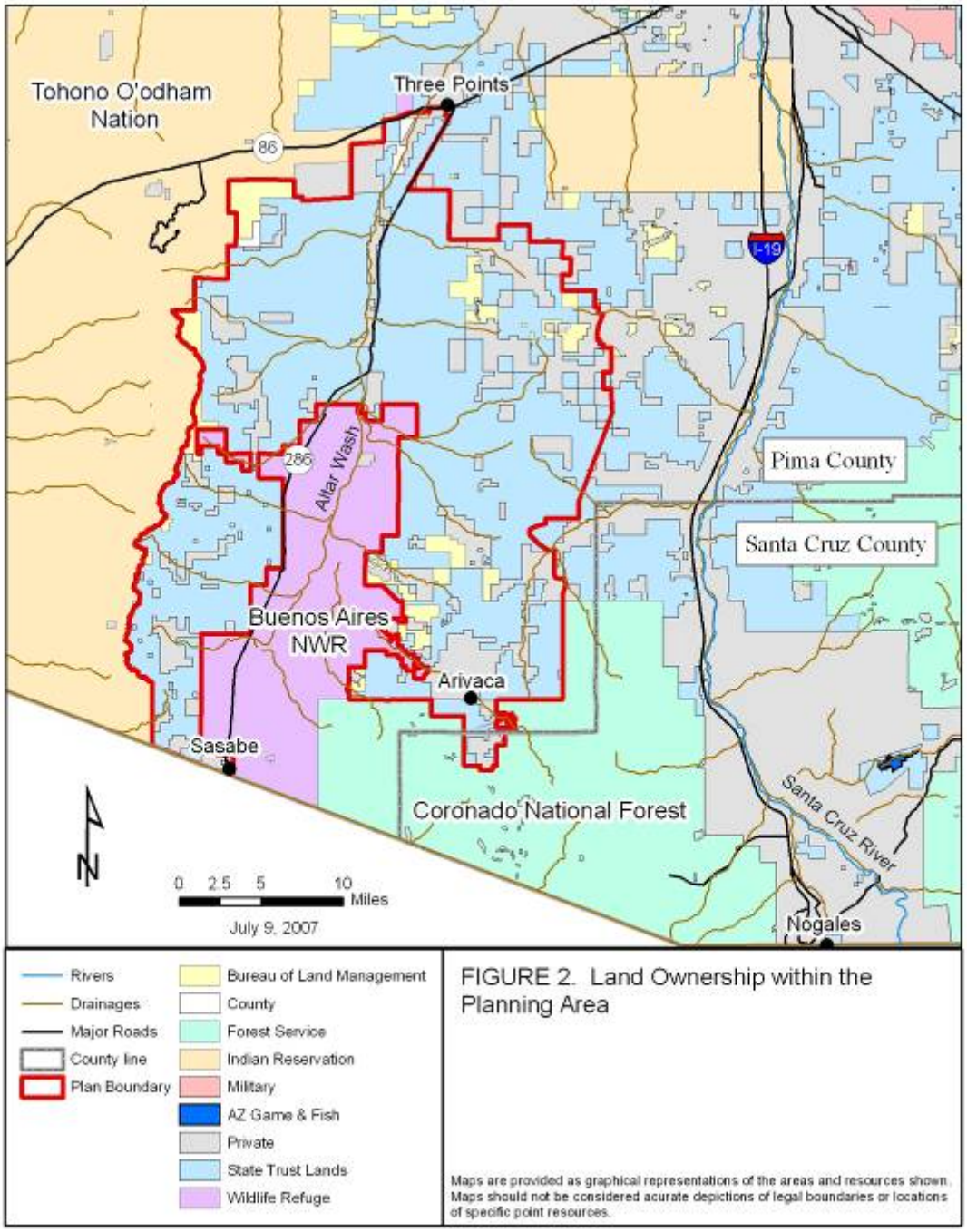
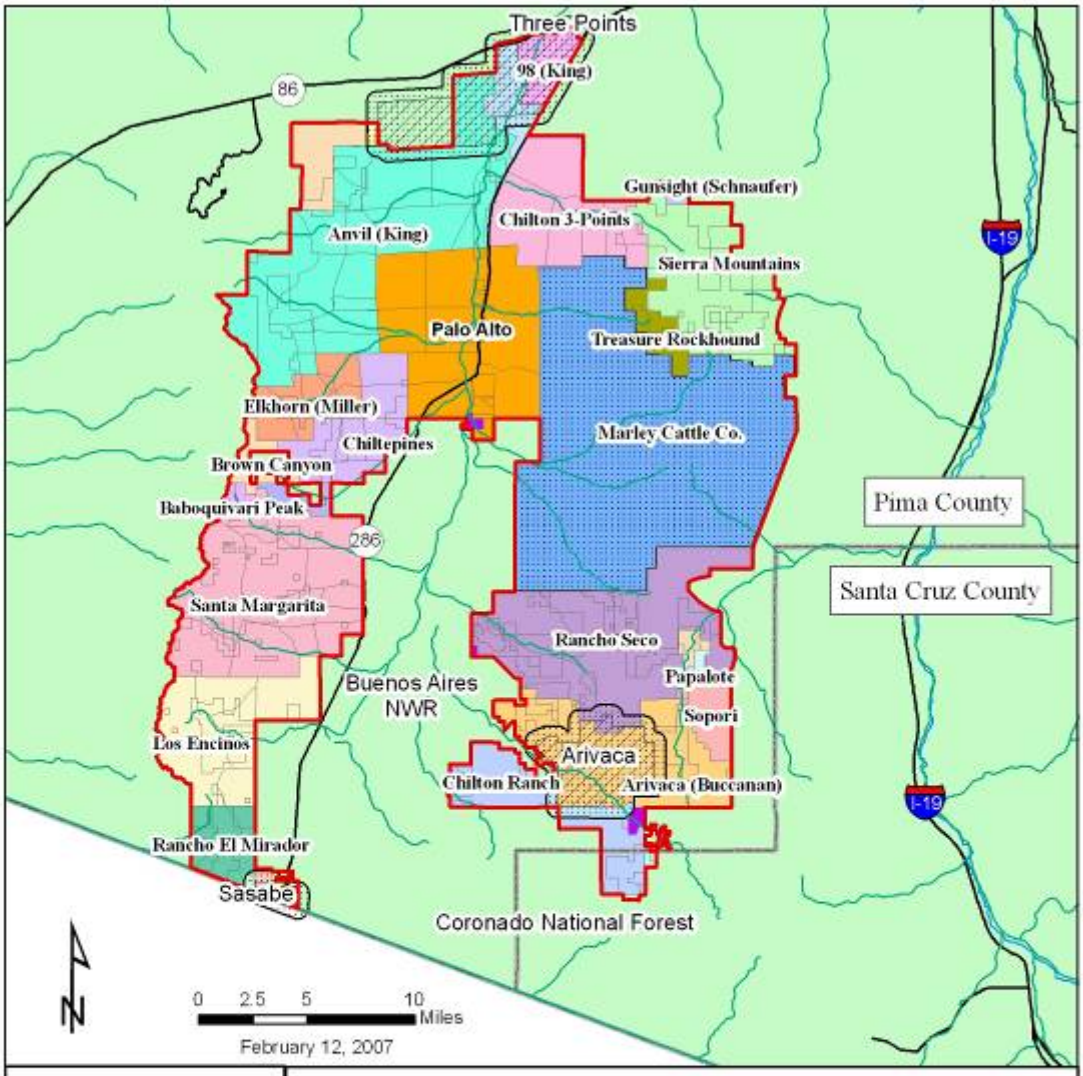


FIGURE 2. Land Ownership within the Planning Area

Maps are provided as graphical representations of the areas and resources shown. Maps should not be considered acurate depictions of legal boundaries or locations of specific point resources.



Project Boundary
Washes
Rivers
Major Roads
counties
Suppression Areas
Residential Development
Fire Management Units

FIGURE 3. Fire Management Units Showing Ranch Associations

Maps are provided as graphical representations of the areas and resources shown. Maps should not be considered acurate depictions of legal boundaries or locations of specific point resources.

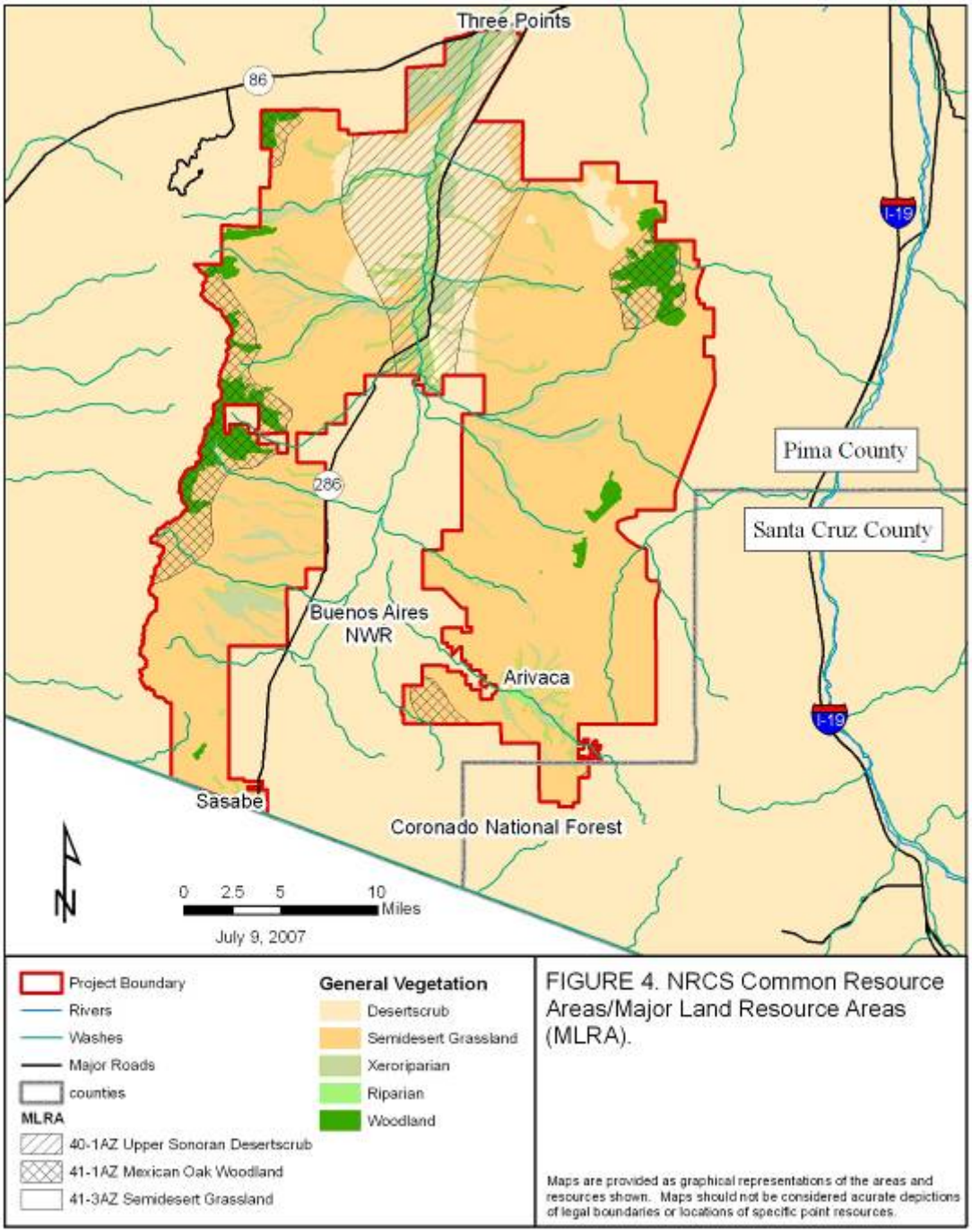


FIGURE 4. NRCS Common Resource Areas/Major Land Resource Areas (MLRA).

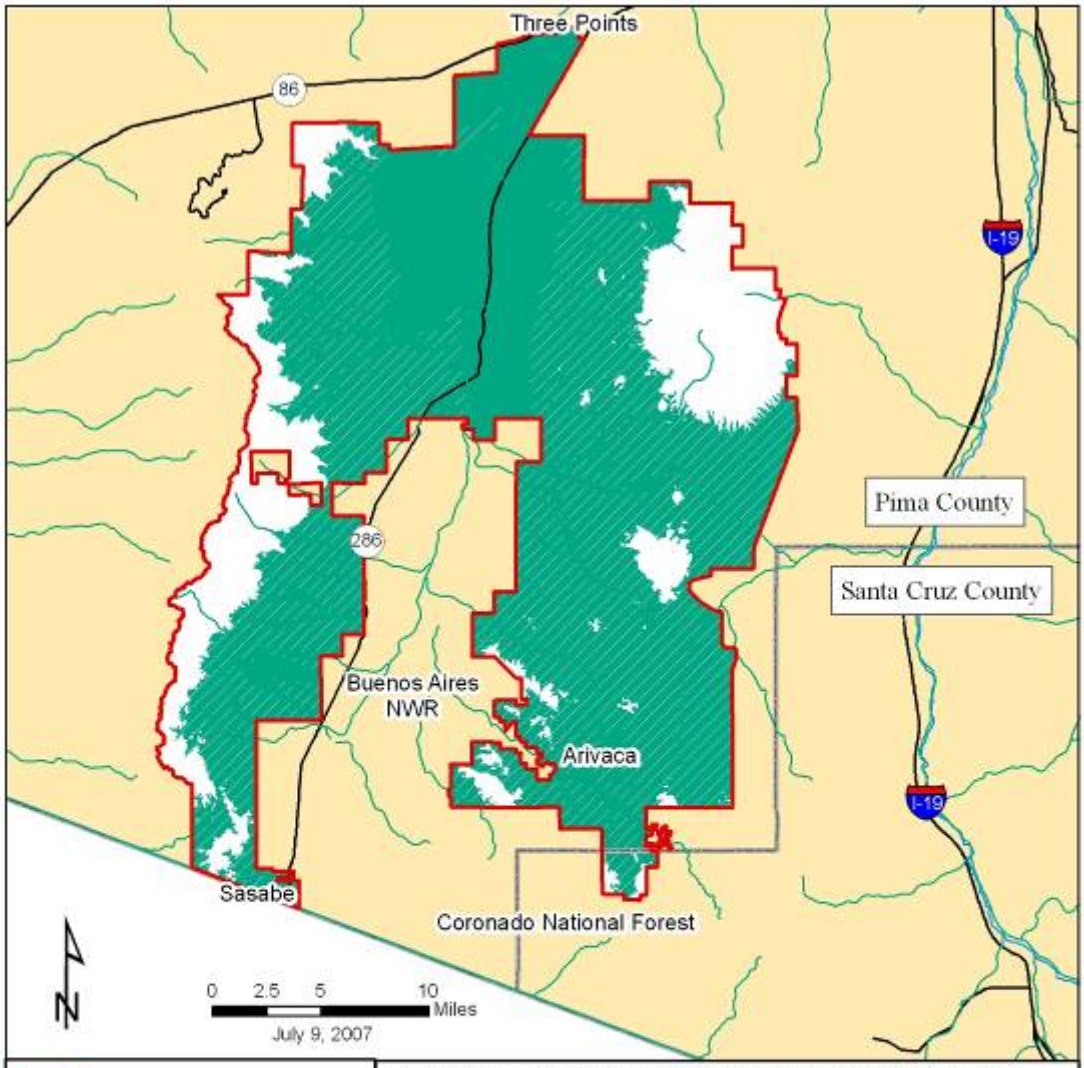
Project Boundary
Washes
Rivers
counties

Pima pineapple cactus

Potential habitat
Non-habitat

FIGURE 5. Illustration of the Extent of Pima Pineapple Cactus Potential Habitat Based Upon Elevation and Plant Community Association.

Implementation of conservation measures should be based upon actual site condition on the ground and not this illustration. Suitability of potential habitat should be based upon the known habitat features for this species. Maps are provided as graphical representations of the areas and resources shown. Maps should not be considered acurate depictions of legal boundaries or locations of specific point resources.



Project Boundary
Washes
Rivers
counties

Cactus ferruginous pygmy-owl

Potential habitat
Non-habitat

FIGURE 6. Illustration of Potential Cactus Ferruginous Pygmy-owl Habitat. This Illustration is based upon elevation and rough plant community boundaries. White cross-hatches indicate semidesert grassland plant community where patches of suitable habitat may exist.

Implementation of conservation measures should be based upon actual site condition on the ground and not this illustration. Suitability of potential habitat should be based upon the known habitat features for this species. Maps are provided as graphical representations of the areas and resources shown. Maps should not be considered acurate depictions of legal boundaries or locations of specific point resources.

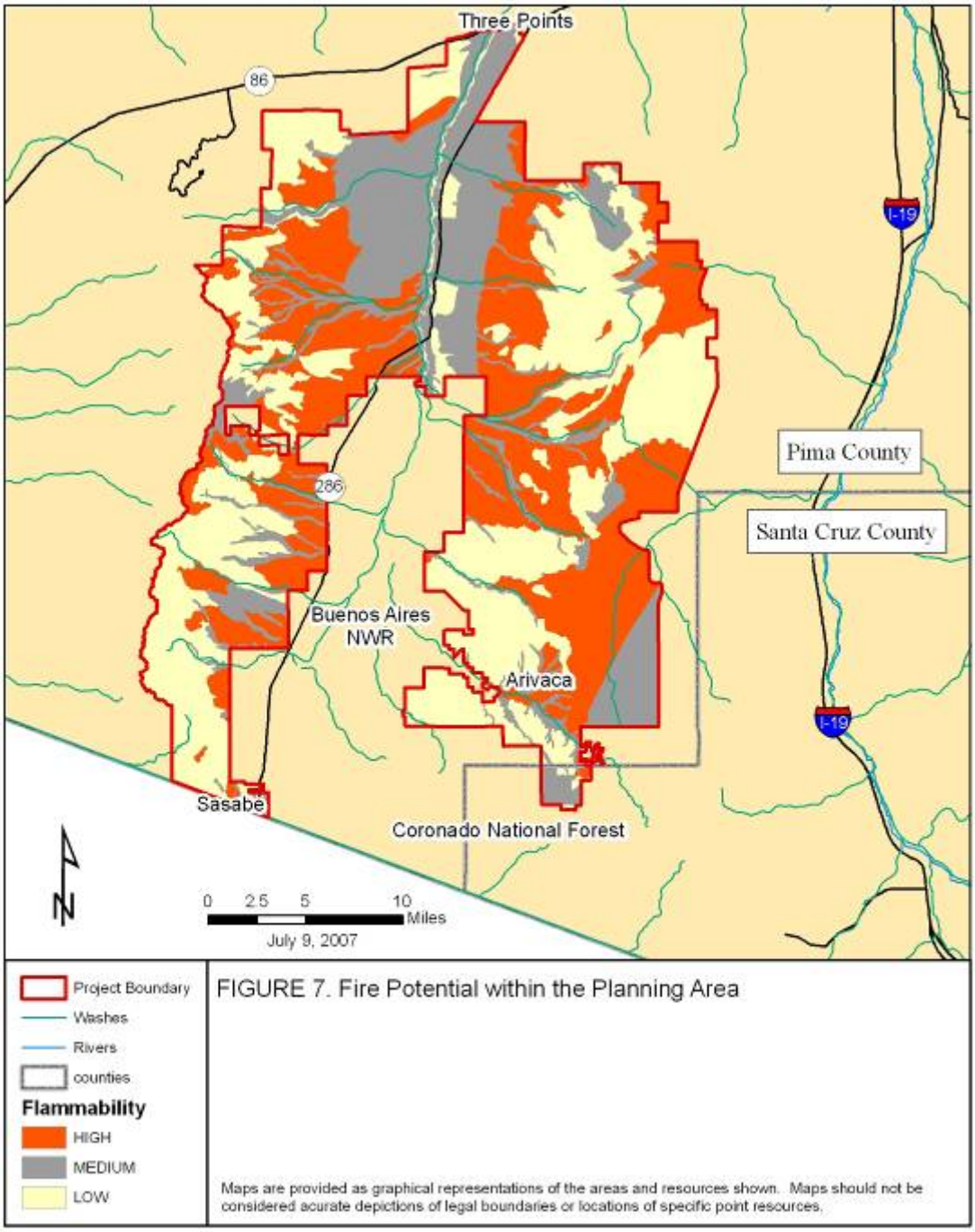


FIGURE 7. Fire Potential within the Planning Area

Maps are provided as graphical representations of the areas and resources shown. Maps should not be considered acurate depictions of legal boundaries or locations of specific point resources.

Appendix B

Fire Regimes, Condition Classes, and Fuels Models

Appendix C

Biological Assessment