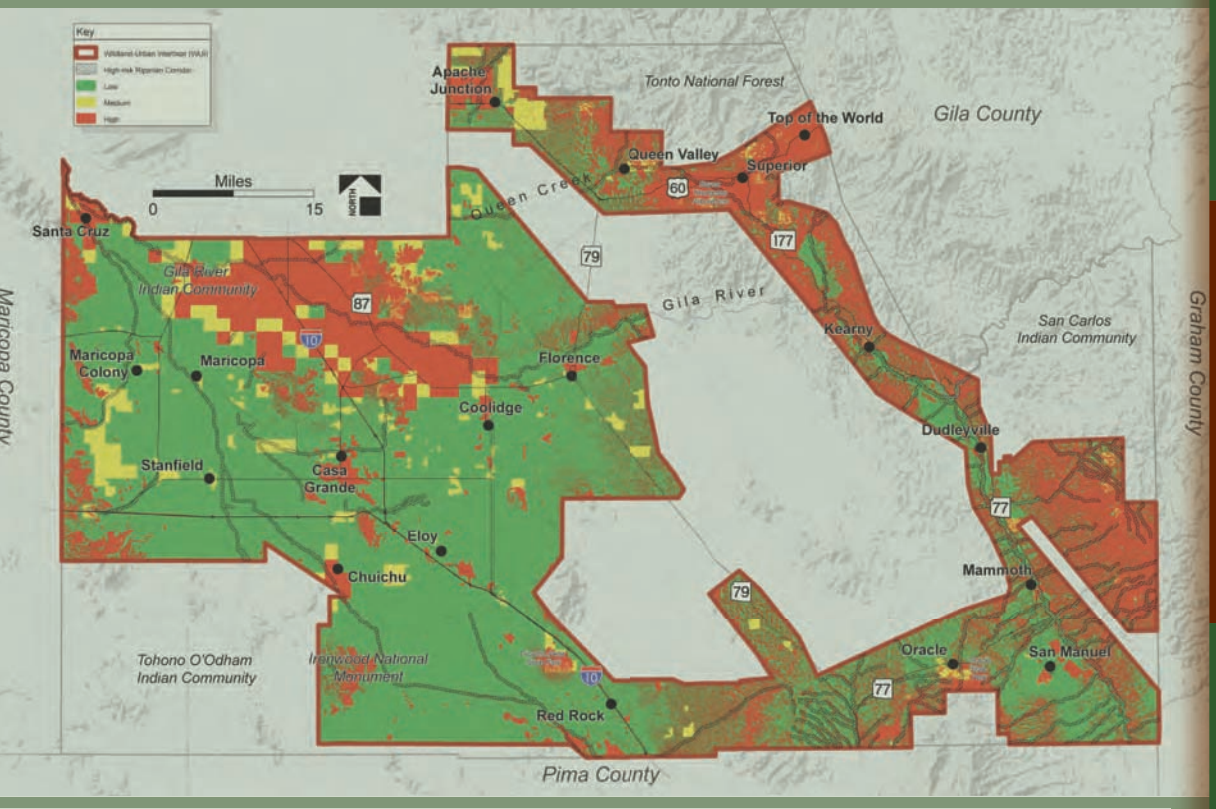
# Pinal County
## Community Wildfire Protection Plan

Dudleyville ▪ Kearny ▪ Oracle ▪ Santa Cruz ▪ Maricopa Colony
Top of the World ▪ Florence ▪ Coolidge ▪ Queen Valley
Arizona City ▪ Avra Valley ▪ Thunderbird Farms ▪ Picacho
Apache Junction ▪ Queen Creek ▪ Eloy ▪ Superior
San Manuel ▪ Casa Grande ▪ Mammoth ▪ Maricopa
Stanfield ▪ Oracle Junction/Saddlebrook ▪ Chuichu




*Pinal County Board of Supervisors*
*City of Casa Grande*
*City of Apache Junction*
*Town of Florence*
*Town of Kearny*
*City of Maricopa*
*Town of Superior*
*Apache Junction Fire District*
*Arizona City Fire District*
*Avra Valley Fire District*
*Dudleyville Fire District*
*Eloy Fire District*
*Golder Ranch Fire District*
*Grande Buttes Fire District*
*Mammoth Fire District*
*Oracle Fire District*
*Queen Valley Fire District*
*San Manual Fire District*
*Stanfield Fire District*
*Thunderbird Fire District*
*Casa Grande Fire Department*
*Coolidge Fire Department*
*Florence Fire Department*
*Kearny Fire Department*
*Maricopa Fire Department*
*Superior Fire Department*
*Ak-Chin Indian Community*
*Tohono O'odham Nation*
*Gila River Indian Communities*

**FEBRUARY 2009**

# Pinal County
# Community Wildfire Protection Plan

**February 2009**

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# TABLE OF CONTENTS

## APPENDIXES



## LIST OF TABLES



## LIST OF FIGURES

## LIST OF PHOTOS

## ACRONYMS AND ABBREVIATIONS

| | |
|---|---|
| ASLD | Arizona State Land Department |
| ASFD | Arizona State Forestry Division |
| ASP | Arizona State Parks Department |
| BA | basal area |
| BAER | burned area emergency response |
| BLM | Bureau of Land Management |
| CNF | Coronado National Forest |
| CWPP | community wildfire protection plan |
| dbh | diameter at breast height |
| drc | diameter at root collar |
| FO | BLM Field Office |
| FRCC | fire regime condition class |
| FS | Forest Service |
| GIS | geographic information system |
| GPS | Global Positioning System |
| HFRA | Healthy Forests Restoration Act of 2003 |
| IGA | intergovernmental agreement |
| IMS | Federal Wildland Fire Occurrence Internet Mapping Service |
| ISO | Insurance Services Office |
| NFDRS | National Fire Danger Rating System |
| PCOEM | Pinal County Office of Emergency Management |
| PNVG | potential natural vegetation group |
| $R_x$ | prescribed fire |
| SR | state route |
| SWReGAP | Southwest Regional Gap Analysis Project |
| TES | Threatened, endangered, and sensitive species |
| TNF | Tonto National Forest |
| USDA | United States Department of Agriculture |
| USDI | United States Department of the Interior |
| WUI | wildland-urban interface |

# EXECUTIVE SUMMARY:
# PINAL COUNTY COMMUNITY WILDFIRE PROTECTION PLAN

The Pinal County Community Wildfire Protection Plan (CWPP) was developed in response to the Healthy Forests Restoration Act of 2003 (HFRA) for the at-risk communities and unincorporated areas in Pinal County, Arizona, located in and around public lands administered by the US Department of the Interior Bureau of Land Management (USDI BLM) Gila District Office, Safford and Tucson Field Offices; the USDI BLM Phoenix District Office, Lower Sonoran Field Office; the Tonto National Forest (TNF); and the Coronado National Forest (CNF). HFRA established unprecedented incentives for communities to develop comprehensive wildfire protection plans in a collaborative, inclusive process. Furthermore, this legislation gives direction to BLM and the US Forest Service to address local community priorities in fuel reduction treatments, even on nonfederal lands. For a community to take full advantage of the opportunities provided in HFRA, it must first prepare a CWPP. A CWPP developed in accordance with HFRA is the most effective way to acquire federal funding for fire preparedness and planning. Pinal County, partner agencies, and participating communities wish to adopt a CWPP to better protect their communities from wildfire risk, to better prepare citizens, and to become eligible to apply for and receive federal and other grant monies to implement wildland fire mitigation projects and programs.

To ensure that all residents of Pinal County were represented in this planning process, two Core Teams were formed to implement the agency and public collaboration necessary to develop a CWPP compliant with HFRA: the Eastern Core Team includes all identified at-risk communities in Pinal County located east of State Route 79 and north of US Highway 60, and the Western Core Team includes all identified at-risk communities west of State Route 79 and south of US Highway 60. The Core Teams agreed to and established an efficient process to be followed throughout the Pinal County CWPP development. The Core Teams analyzed 1,986,077 acres including 24 communities comprised of 150 separate wildland fire treatment areas for potential risk from catastrophic wildland fire within Pinal County.

## Section I. Introduction

A primary objective of a CWPP is to help local governments, fire departments and districts, and residents identify at-risk public and private lands to better protect those lands from severe wildfire threat. Additional functions of a CWPP are to improve fire prevention and suppression activities, as well as to identify funding needs and opportunities to reduce the risk of wildland fire and enhance public and firefighter safety. Identifying at-risk areas and improving fire protection capabilities helps the communities to prioritize high-risk projects and expedites overall project planning. Pinal County's CWPP was created to meet these objectives at a local level while integrating with overall federal- and state-level fire planning.

The Core Teams identified needed agency and organization partners and interested parties to initiate the collaborative process and to establish the following overarching goals of the Pinal County CWPP:

- Improve fire prevention and suppression, emphasizing firefighter and public safety
- Reduce hazardous fuels, emphasizing public and private property protection
- Restore forest, rangeland, and riparian health
- Promote community involvement and provide for community protection

- Recommend measures to reduce structural ignitability in the wildland-urban interface (WUI)
- Encourage economic development in the communities from vegetative treatments
- Promote development of wildfire emergency evacuation and communication plans
- Integrate use of the CWPP with surrounding community and agency fire management plans

The Core Teams developed and concurred with the process that was to be followed in developing the Pinal County CWPP. This section establishes all necessary planning components and clearly articulates the intent of the Pinal County CWPP and ensures that the CWPP is compliant with HFRA.

**Section II. Community Assessment**

Section II covers the methods used in community wildfire risk assessments, the identification of the WUI, and the identification of communities with high, moderate, and low wildland fire risk within the WUI. Environmental elements used by the Core Teams to identify the WUI include wildland vegetative fuel hazards, comparison of average and extreme rainfall years, consideration of aspect and local topography, historical fire occurrence, and wildfire ignition history. These environmental factors were coupled with community-based characteristics and values, such as local fire resource preparedness, infrastructure, evacuation routes, and population/structure density. An external element, the Fire Insurance Service Organization (ISO) ratings, was also used in determining wildland fire risk to communities within the WUI. These elements were all identified and combined using spatial analysis within a geographic information system (GIS). As a result of the GIS analysis, a WUI and sub-WUI boundary map and a wildfire risk rating map were created. Sub-WUIs were divided into treatment management areas, according to high, moderate, and low fuel hazard. Several components, including slope, aspect, vegetation type, vegetation density, ground fuel loads, and treated areas, were used to make fuel hazard determinations. The Pinal County CWPP analysis consisted of 1,986,077 acres of federal, state, and private lands. Cumulative risk levels across the Pinal County CWPP analysis area include 458,479 acres (23%) of high wildland fire risk, 114,654 acres (6%) of moderate risk, and 1,412,944 acres (71%) of low risk.

**Section III. Community Mitigation Plan**

Section III prioritizes the areas in need of wildland fuel mitigation and recommends the types and methods of treatment and management necessary to mitigate the potential for catastrophic wildland fire in the WUI. Also presented in this section are the Pinal County CWPP communities' recommendations for enhanced wildland fire protection capabilities; public education, information, and outreach; and support for local wood product, woody biomass, and wildland vegetative fuel management businesses and industries.

As part of the community mitigation plan, the Core Teams identified the Pinal County CWPP administrators—the Fire Chief Association of Pinal County, Pinal County Office of Emergency Management, TNF, CNF, Arizona State Forestry Division, and BLM—who will be mutually responsible for implementing and monitoring Pinal County CWPP action recommendations in coordination with a future established countywide community Working Group. Pinal County CWPP administrators are responsible for ensuring implementation of the Pinal County CWPP, for preparing reports and work plans, and for developing community bulletins and public service announcements that inform residents of wildfire dangers and preventive measures. Additional tasks include assisting federal and state agencies and private

landowners to identify appropriate funding sources to implement action recommendations of the Pinal County CWPP, as well as continued coordination with communities outside the analysis area. Pinal County CWPP administrators are also responsible for coordinating monitoring and reporting of implementation actions that will allow for enhanced coordination of management programs and that will reduce inconsistencies among local, state, and federal agencies.

To prioritize treatments, the Core Teams identified 150 wildland fuel treatment areas within 21 sub-WUI designations of the WUI. These treatment areas were analyzed and categorized according to potential risk for wildfire. Each area was also ranked and described along with a recommendation for its preferred treatment type and method. Preferred treatments were recommended for treatment management areas identified as high risk. These treatments are designed to meet the fuel reduction and modification objectives of the Pinal County CWPP.

**Section IV. Pinal County CWPP Priorities: Action Recommendations and Implementation**

During the development of the Pinal County CWPP, the Core Teams identified action recommendations necessary to achieve the goals outlined in the plan. The first action recommendation was to identify priority treatment areas for fuel reduction projects. Treatment areas were identified within the WUI to create defensible space through treatments within the home ignition zone, the use of strategically placed fuelbreaks, and the modification of hazardous wildland fuels. The objective of a fuels reduction project is to create an acceptable vegetation condition class for community and infrastructure protection and public and firefighter safety. Priority treatment management areas were designated in areas identified as high risk. Table 4.1 in Section IV lists the priority action recommendations for the reduction of hazardous fuels within the Pinal County CWPP area. The second action recommendation identified by the Core Teams was to reduce structural ignitability. Reduction of structural ignitability is achieved through evaluation; maintenance; and, at times, upgrades to community response facilities, capabilities, and equipment. The third action recommendation described is the promotion of community involvement; action items include community education, information, and outreach.

**Section V. Monitoring Plan**

The monitoring plan, outlined in Section V, describes how implementation and monitoring of the Pinal County CWPP will occur. The Pinal County CWPP administrators are responsible for implementation and monitoring. Implementation begins by securing grants and other funding necessary to execute the action items.

The Pinal County CWPP administrators will provide an annual report of successful grant awards and projects implemented as a result of those awards. The administrators will also update work plans based on projects completed in the previous years.

**Acknowledgments**

The following communities and agencies were involved in the preparation of the Pinal County CWPP:

Arizona State Forestry Division

Municipal fire departments and local fire districts

Municipalities of Florence, Casa Grande, Coolidge, Apache Junction, Queen Creek, Eloy, Mammoth, Kearny, and Superior

Pinal County Office of Emergency Management

US Department of the Interior Bureau of Land Management

Tonto National Forest

Coronado National Forest

Ak-Chin Indian Community

Gila River Indian Community

Tohono O'Odham Nation

Pinal County Cooperative Extension Service

# I. INTRODUCTION

The Pinal County Community Wildfire Protection Plan (CWPP) was developed in response to the Healthy Forests Restoration Act of 2003 (HFRA) for the at-risk cities and unincorporated areas in Pinal County, Arizona (see Figure 1.1), located around public lands administered by the following agencies: the US Department of the Interior (USDI) Bureau of Land Management (BLM) Gila District Office, Safford and Tucson Field Offices (FOs); the USDI BLM Phoenix District Office, Lower Sonoran FO; the Tonto National Forest (TNF); and the Coronado National Forest (CNF). HFRA established unprecedented incentives for communities to develop comprehensive wildfire protection plans in a collaborative, inclusive process. Furthermore, this legislation gives direction to BLM to address local community priorities in fuel reduction treatments, even on nonfederal lands.

Congress passed HFRA in November 2003, and the President signed it into law that December. When certain conditions are met, Title I of HFRA authorizes the Secretaries of Agriculture and the Interior to expedite the development and implementation of hazardous fuel reduction projects on federal, tribal, state, and private lands.

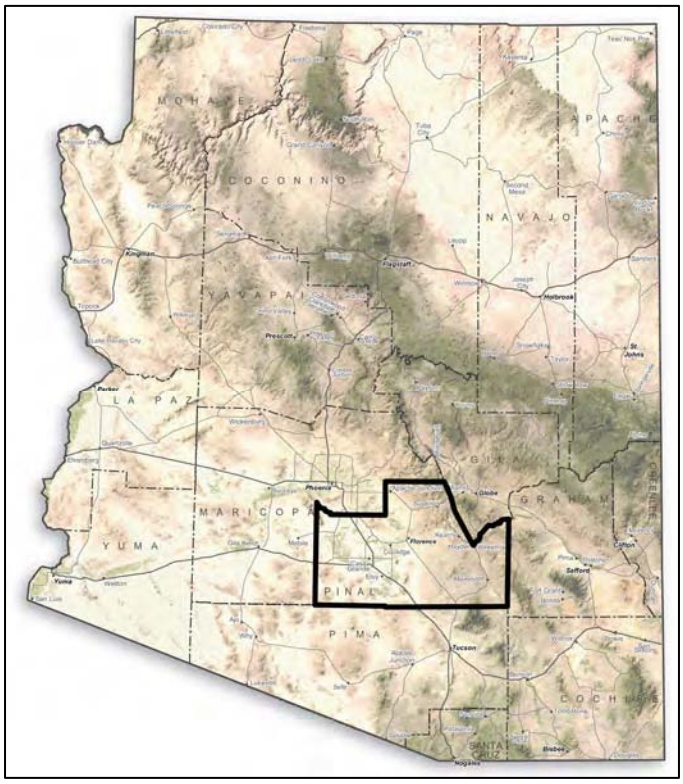



**Figure 1.1.** Analysis area

HFRA requires federal agencies to collaborate with communities in developing hazardous fuel reduction projects and places priority on treatment areas identified by communities through the development of a CWPP. Priority areas include the wildland-urban interface (WUI), municipal watersheds, areas affected by windthrow or insect or disease epidemics, and critical wildlife habitat that would be negatively affected by a catastrophic wildfire.

In compliance with Title 1 of HFRA, the CWPP requires agreement among local governments, local fire departments and districts, and the state agency responsible for forest management. For the Pinal County CWPP, this agency is the Arizona State Forestry Division (ASFD). The CWPP must also be developed in consultation with interested parties and the applicable federal agency managing the public lands surrounding the at-risk communities. The majority of lands surrounding the at-risk communities and unincorporated intermixed community zones within Pinal County are located adjacent to "public lands," as defined in Sections 3.1.A and B of HFRA; Indian tribal lands, as defined in Section 3.2 of HFRA; and Arizona state trust lands.

The Pinal County CWPP has been developed to assist local governments, fire departments and districts, and residents to identify lands—including federal lands—at risk from severe wildfire threat and to identify strategies for reducing hazardous vegetative fuels within the WUI while improving watershed and

rangeland health, supporting local industry and local economies, and improving public and firefighter safety and response capabilities. The Pinal County CWPP is based on the *Approved Arizona Statewide Land Use Plan Amendment for Fire, Fuels, and Air Quality Management and Decision Record (*USDI BLM 2004a); *Amendment 25 to the Tonto National Forest Land and Resource Management Plan* (USDA FS 2006), the *Wildland Fire Amendment to the Coronado National Forest Land and Resource Management Plan* (USDA FS 2005b); and the *Statewide Strategy for Restoring Arizona's Forests* (Governor's Forest Health Councils 2007). This CWPP has been developed in consultation with the BLM Phoenix and Gila Districts to help Pinal County and the State of Arizona implement the recommendations of Pinal County and to help the Arizona State Land Department (ASLD); ASFD; TNF; CNF, 13 participating fire districts; 3 tribal fire departments; the municipal fire departments of Florence, Coolidge, Superior, Casa Grande, Kearny, and Maricopa; and community residents identify lands at risk from severe wildfire threat. It also allows those entities to identify strategies for reducing vegetative fuels within the WUI while improving riparian and rangeland health, supporting local industry, making recommendations for reducing structural ignitability, developing public education and outreach, and improving public and firefighter safety and response capabilities. The Pinal County CWPP is based on guidance from *Preparing a Community Wildfire Protection Plan: A Handbook for Wildland-Urban Interface Communities* (Communities Committee et al. 2004). To ensure that all residents of Pinal County were represented in this planning process, two Core Teams were formed to implement the agency and public collaboration necessary to develop a CWPP compliant with HFRA: the Eastern Core Team includes all identified at-risk communities in Pinal County located east of State Route 79 (SR 79) and north of US Highway 60 (US 60), and the Western Core Team includes all identified at-risk communities west of SR 79 and south of US 60. The Core Teams agreed to and established an efficient process to be followed throughout the Pinal County CWPP development. The Core Teams identified 25 communities and analyzed 1,986,077 acres for potential risk from catastrophic wildland fire within Pinal County.

In addition, the Core Teams were formed to ensure that local, state, and federal management recommendations for wildland fire protection, watershed, and riparian health were addressed in the Pinal County CWPP. The Core Teams represent all identified at-risk communities and principal developed areas within Pinal County. As additional guidance documents become available, changes or amendments will be incorporated into the Pinal County CWPP as necessary.

The following sections detail the background and process used to develop the Pinal County CWPP and define the associated WUI. In addition, the desired future condition of lands covered by the Pinal County CWPP is described; current fire policies and programs are identified; and current projects and future needs are discussed. Finally, the goals of the Pinal County CWPP are presented along with an outline of planning methods to achieve those goals.

## A. Background

The process for developing this CWPP consisted of evaluating Pinal County, including tribal trust lands, to identify communities and remote private lands at risk from catastrophic wildland fire. During this analysis the County solicited federal, state, and local governments; fire chiefs; and interested individuals to participate in the Core Teams. The Core Teams were created to define and locate interface and intermix

communities in which significant community values and infrastructure are at risk because of the potential of wildland fire.[1] The Pinal County Office of Emergency Management (PCOEM) requested that local governments, fire departments and districts, BLM, ASFD, CNF, TNF, and interested individuals throughout Pinal County participate in the Core Teams to develop the draft CWPP. Pinal County is the local government authority for the unincorporated communities identified as at risk, while the city or town councils of Florence, Coolidge, Apache Junction, Queen Creek, Eloy, Superior, Casa Grande, Mammoth, Maricopa, and Kearny are the appropriate local governments for Pinal County CWPP agreement for these municipalities. Pinal County and the Core Teams recognize the value of conveying information developed from the Pinal County CWPP process to local citizens. Therefore, the Core Teams provided updates of the Pinal County CWPP development process at public meetings that were held within the county. These public informational meetings were the foundation for general public involvement and information dissemination. This process established by the Core Teams ensures an open public process, with the goal of all community interests being represented during the development of the Pinal County CWPP. The Core Teams, in association with planned public involvement, meets all collaborative guidance criteria established by the Wildland Fire Leadership Council (2002).

The Core Teams and collaborators developed this CWPP to increase preparedness, to reduce hazardous wildland fuels, to reduce impacts from catastrophic wildfire, and to prepare recommendations for reducing structural ignitability. In addition, the Core Teams developed this CWPP to increase communication with local, county, state, and federal emergency response personnel by determining areas of high risk from catastrophic wildland fire; by developing mitigation measures to reduce hazardous wildland fuels; by improving emergency response to unplanned wildfire; by preventing wildfire ignitions from state and public lands from spreading into the WUI and into the communities; and by preventing wildfire ignitions within the WUI from spreading to adjacent state and public lands.

During initial analysis for the proposed wildland fuel mitigation recommendations, as well as the development of the overall plan, the Core Teams reviewed the following documents:

- "Urban Wildland Interface Communities within the Vicinity of Federal Lands That Are at High Risk from Wildfire," *Federal Register* Vol. 66, Nos. 3 and 160 (US Department of Agriculture [USDA] and USDI 2001a and 2001b)
- *Field Guidance: Identifying and Prioritizing Communities at Risk* (National Association of State Foresters 2003)
- *Arizona Wildland Urban Interface Assessment* (Arizona State Forester 2004)
- *Arizona-Identified Communities at Risk.* (Arizona State Forester 2007a)
- *Statewide Strategy for Restoring Arizona's Forests* (Governor's Forest Health Councils 2007)
- *2006 Status Report and Recommendations* (Governor's Arizona Forest Health Oversight Council 2006)

[1]Interface communities exist where structures directly abut wildland fuels; intermix communities exist where structures are scattered throughout a wildland area (USDA and USDI 2001a).

- *A Collaborative Approach for Reducing Wildland Fire Risks to Communities and the Environment: 10-Year Comprehensive Strategy Implementation Plan* (USDA Forest Service [FS] and USDI BLM 2002)
- *Approved Arizona Statewide Land Use Plan Amendment for Fire, Fuels, and Air Quality Management and Decision Record* (USDI BLM 2004a)

The Core Teams also reviewed Section 101.16.B.iii of HFRA to determine an area adjacent to an evacuation route for hazardous fuel reduction measures to provide safer evacuation from an at-risk community. Since 1980, over 3,900 wildfire ignitions have been recorded within the Pinal County CWPP WUI. Large wildfires have become increasingly common in the desert vegetation zones due to the presence of nonnative annual grasses. In total, 21 large wildfires have occurred in or adjacent to the WUI since 2000, burning over 161,700 acres of wildland habitat within the Pinal County CWPP WUI. Catastrophic wildland fire has consistently occurred in some areas of the WUI. For example, the 2002 Oracle Hill Fire burned 24,000 acres near the community of Oracle, and the 2002 Bulluck Fire burned 30,560 acres in the Catalina Mountains south of Oracle. The 2003 Aspen Fire within the CNF Catalina Ranger District grew to over 84,750 acres before being successfully contained southeast of the community of Oracle. The Aspen Fire destroyed 333 structures and cost $17,000,000.00 to suppress.

The fire departments and districts within the county have responded to and suppressed numerous wildland fires within the WUI during the past 10 years. The Core Teams determined that the majority of wildfire starts within the county have occurred within the Gila River Indian Community; within the TNF near the communities of Superior and Top of the World; within the CNF near the community of Oracle; and in the vicinity of the confluence of the San Pedro and Gila Rivers, along the San Pedro River corridor adjacent to State Route (SR) 77 and the communities of Kearny, Dudleyville, and Mammoth. These fires have occurred within saltcedar-invaded riparian communities and higher-elevation chaparral and woodland vegetation associations that threaten the at-risk communities of Pinal County with the potential for catastrophic wildland fire. Continued extreme weather conditions, dry fuels, increased nonnative invasive vegetation, and increased fuel loading on federal and nonfederal lands contribute to the potential for catastrophic wildland fires within Pinal County. As a result, the fire departments and districts and governmental agencies have initiated fire preparedness and land-treatment planning efforts to deal with the types and densities of wildland fuels that significantly threaten communities with potential catastrophic wildfire.

In 2003, Governor Janet Napolitano created the Forest Health Advisory Council and the Forest Health Oversight Council in response to the increasing number, frequency, and intensity of unwanted wildfires threatening Arizona communities and forests (Executive Order 2003-16). The councils were directed to develop scientific information and policy recommendations to advise the Governor's administration on matters of forest health, unnaturally severe forest fires, and community protection. In 2005, the councils established a subcommittee to begin work on a 20-year strategy to restore forest health, protect communities from fire, and encourage forest-based economic activity. Governor Napolitano approved and signed the *Statewide Strategy for Restoring Arizona's Forests* in June 2007. The Core Teams have reviewed the strategy—specifically, the Sky Islands landscapes—to ensure that the recommendations adopted by the Core Teams and presented within the Pinal County CWPP comply with, and complement,

the *Statewide Strategy for Restoring Arizona's Forests*. Using the information gathered from these supporting documents, the Core Teams and collaborators agreed that the Pinal County communities listed in the *Arizona-Identified Communities at Risk* (Arizona State Forester 2007a), as well as other developed areas identified as at risk within the Pinal County CWPP WUI, constitute interface or intermix communities (see USDA and USDI 2001a; Arizona State Forester 2007b) at risk from wildland fire.

### B. WUI and Delineation Process

In 2007, six communities were included in the *Arizona-Identified Communities at Risk* (Arizona State Forester 2007a) and were given a WUI risk rating for catastrophic wildland fire. The Core Teams and collaborators concur with the listing of at-risk communities within the *Arizona-Identified Communities at Risk* (Arizona State Forester 2007a), as maintained by the Arizona State Forester. The Core Teams and collaborators recommend maintaining the original four nontribal and two tribal communities based on the results of the Pinal County CWPP wildland fire analysis and further recommend including the following Pinal County communities, along with their associated WUI risk ratings, in the *Arizona-Identified Communities at Risk* (Arizona State Forester 2007a).

| Community[a] | WUI risk | Fire department/ district | Community | WUI risk | Fire department/ district |
|---|---|---|---|---|---|
| Dudleyville | Moderate | Dudleyville Fire District | Apache Junction | Low | Apache Junction Fire District |
| Kearny | High | Kearny Fire Department | Queen Creek | Low | Queen Creek Fire Department |
| Oracle | High | Oracle Fire District | Eloy | Low | Eloy Fire District |
| Santa Cruz | Moderate | Gila River Indian Community Fire Department | Superior | High | Superior Fire Department |
| Maricopa Colony | Low | Ak-Chin Indian Community Fire Department | San Manuel | Low | San Manuel Fire District |
| Top of the World | High | None | Casa Grande | Low | Casa Grande Fire Department |
| Florence | Moderate | Florence Fire Department | Mammoth | Low | Mammoth Fire District |
| Coolidge | Low | Coolidge Fire Department | Maricopa | Low | Maricopa Fire Department |
| Queen Valley | High | Queen Valley Fire District | Stanfield | Low | Stanfield Fire District |
| Arizona City | Low | Arizona City Fire District | Oracle Junction/Saddlebrook | Moderate | Golder Ranch Fire District |
| Avra Valley | Low | Avra Valley Fire District | Galiuro Mountains | Low | None |
| Thunderbird Farms | Low | Thunderbird Fire District | Chuichu | Moderate | Tohono O'odham Nation Fire Department |
| Picacho | Low | None | | | |

[a]Dudleyville listed as low, Kearny listed as moderate, Oracle listed as high, Santa Cruz listed as moderate, Maricopa Colony listed as low, and Top of the World listed as high on the 2007 *Arizona Communities at Risk Matrix* (http://www.azsf.az.gov).

The Pinal County CWPP analyzes risk and makes recommendations to reduce the potential for unwanted wildland fire to the 16 at-risk communities in Pinal County, including tribal trust lands. The Pinal County

CWPP analysis further refines components of wildland fire risk and prioritizes community recommendations for reducing wildland fire potential through vegetative fuel management and public outreach/education and for reducing structural ignitability. Figure 1.2 summarizes the process that the Core Teams followed to produce the Pinal County CWPP. At the far right of each tier is the "product" resulting from the activities in that tier. These tiers correspond to the sections in the Pinal County CWPP and serve as a guide for the rest of this document.

According to HFRA, an "(1) At-risk community . . . means an area – (A) that is comprised of – (i) an interface community . . . or (ii) a group of homes and other structures with basic infrastructure and services . . . within or adjacent to Federal land; (B) in which conditions are conducive to a large-scale wildland fire disturbance event; and (C) for which a significant threat to human life or property exists as a result of a wildland fire disturbance event" (Secs. 101.1.A.i–ii, 101.1.B, and 101.1.C).

The at-risk communities within Pinal County are adjacent to federal lands, including public lands administered by BLM, TNF, and CNF, and are consistent with the Arizona State Forester's (2007b:1) definition of an *intermix* or *interface community*:

> The Intermix Community exists where structures are scattered throughout a wildland area. There is no clear line of demarcation; wildland fuels are continuous outside of and within the developed area. The developed density in the intermix community, ranges from structures very close together to one structure per forty acres. Local fire departments and/or districts normally provide life and property fire protection and may also have wildland fire protection responsibilities.
>
> The Interface Community exists where structures directly abut wildland fuels. There is a clear line of demarcation between wildland fuels and residential, business, and public structures. Wildland fuels do not generally continue into the developed area. The development density for an interface community is usually three or more structures per acre, with shared municipal services. Fire protection is generally provided by a local fire department with the responsibility to protect the structure from both an interior fire and an advancing wildland fire.

In addition to a community's listing status, the current condition of the wildland fuels within and adjacent to at-risk communities significantly contributes to the possibility of a catastrophic wildfire capable of damaging or destroying community values, such as houses, infrastructure, recreational sites, businesses, and wildlife habitats. Establishing a CWPP to enhance the protection of community values, and to minimize the potential loss of property while ensuring public and firefighter safety during a catastrophic wildfire, remains the overriding priority recommendation of the Pinal County CWPP.

The WUI is commonly described as the zone where structures and other features of human development meet and intermingle with undeveloped wildland or vegetative fuels. Communities in the WUI face substantial risk to life, property, and infrastructure. Wildland fire in the WUI is one of the most dangerous and complicated situations firefighters face. Both the *National Fire Plan* (USDA FS and USDI BLM 2004b), which is a response to catastrophic wildfires, and *A Collaborative Approach for Reducing Wildland Fire Risks to Communities and the Environment: 10-Year Comprehensive Strategy Implementation Plan* (USDA FS and USDI BLM 2002), which is a plan for reducing wildland fire risk, emphasize working collaboratively with communities in the WUI to reduce their risk from large-scale wildfire. HFRA builds on existing efforts to

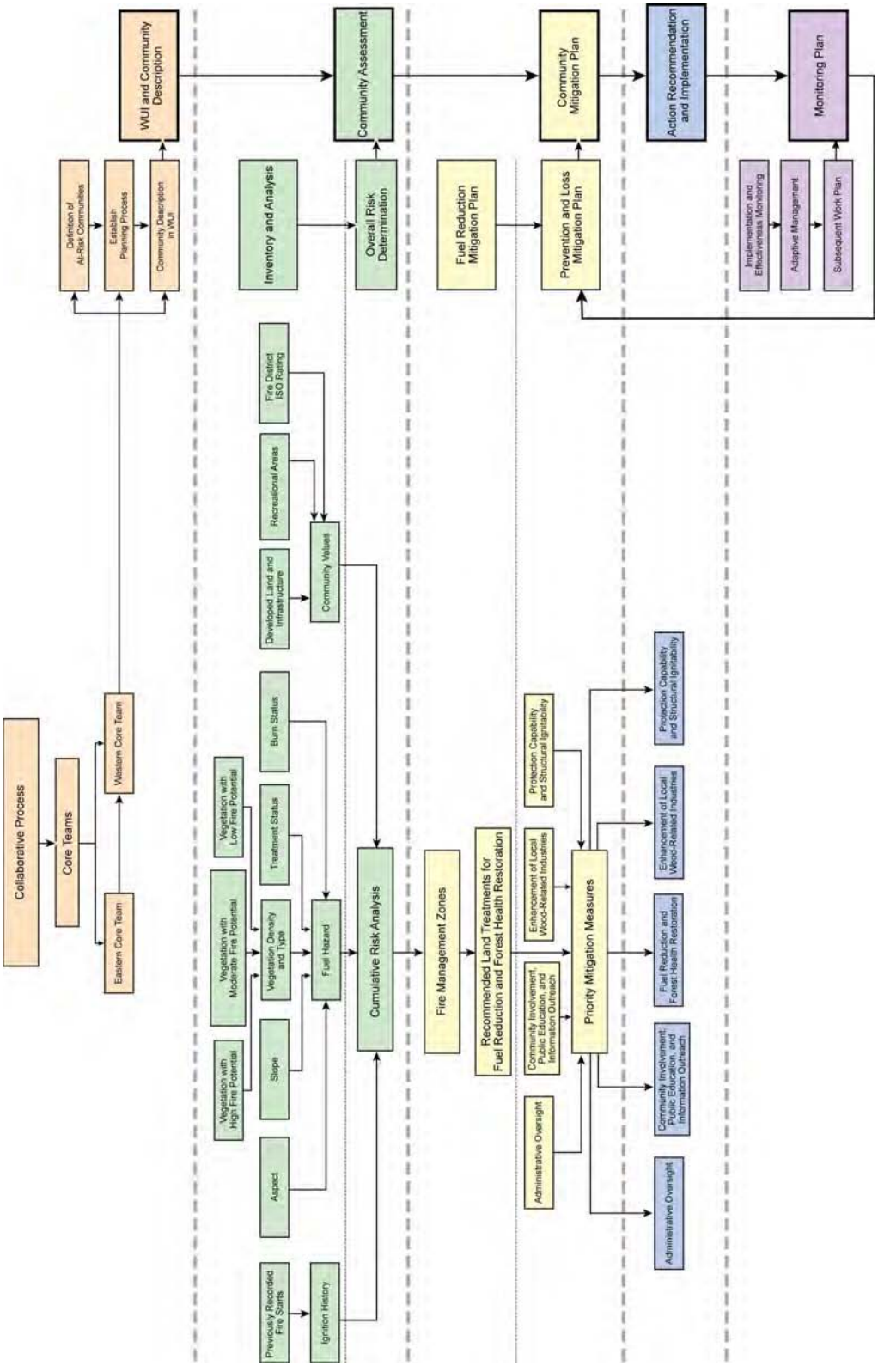



**Figure 1.2.** Pinal County CWPP process

restore healthy wildland conditions in the WUI by empowering local communities to determine the extent of the WUI; by determining appropriate wildland fuel mitigation measures; by enhancing public education for the prevention of wildland fire; and by authorizing expedited environmental assessments, administrative appeals, and legal review for qualifying projects on federal land.

The Pinal County CWPP process of delineating WUI boundaries for at-risk communities involved collaboration among local, state, and federal government representatives as well as interested individuals within the communities. The Pinal County CWPP WUI is the minimum area needed to provide protection to each community and its surrounding community values. The identified WUI includes a total of 1,986,077 acres composed of a mix of private, county, state, tribal trust, and federal lands. The WUI lands that surround the communities are in a condition conducive to a large-scale wildland fire, and such a wildfire could threaten human life and properties (see Photo 1.1).

**Photo 1.1.** 2005 wildfire in the Pinal County CWPP WUI

General elements used in creating the WUI for Pinal County at-risk communities include the following:

- Fuel hazards, local topography, vegetative fuels, and natural firebreaks
- Historical fire occurrence
- Community development characteristics
- Firefighting preparedness
- Infrastructure and evacuation routes
- Recreation and wildlife values

### C. Desired Future Condition and Wildfire Mitigation in the WUI

The desired future condition of Pinal County CWPP lands includes the maintenance of, or return to, wildland fire resiliency status and the maintenance of, or return to, the vegetation component of the historical plant potential community across Pinal County. This historical plant potential community is composed of desert scrublands, shrublands (pinyon-juniper/Mogollon chaparral/sagebrush), riparian

corridors, and semidesert grasslands; all of these plant communities have an associated shrub community, and some are also composed of invasive grasses and woody species (NatureServe 2004, Gori and Enquist 2003). The Core Teams intend the Pinal County CWPP to complement objectives of the BLM, TNF, and CNF; the *Statewide Strategy for Restoring Arizona's Forests* (Governor's Forest Health Councils 2007); the *Approved Arizona Statewide Land Use Plan Amendment for Fire, Fuels, and Air Quality Management and Decision Record* (USDI BLM 2004a); the *Wildland Fire Amendment to the Coronado National Forest Land and Resource Management Plan* (USDA FS 2005b); *Amendment 25 to the Tonto National Forest Land and Resource Management Plan* (USDA FS 2006); and the *Oracle Community Wildfire Protection Plan* (Oracle Fire District 2008). The desired future condition of public lands is consistent with those described by the Core Teams—community wildfire protection, watershed and rangeland restoration, and protection of community values, as well as the restoration of native vegetation to historical wildfire return intervals. Vegetative types maintained in this historical condition allow natural processes such as fire to be incorporated into long-term management practices to sustain habitat health, and to also meet management goals of the Pinal County CWPP while providing for community protection from unwanted wildland fire. Public education and land treatment projects in the Pinal County CWPP area, coupled with current efforts of local governments, fire departments and districts, TNF, CNF, and BLM, will create a better-informed constituency capable of protecting at-risk communities through restoration and vegetative fuels mitigation efforts within the WUI. Federal wildfire reduction policy on public lands is planned and administered primarily by tribal governments, BLM, TNF, and CNF, which are the federal governing agencies for the public lands associated with the Pinal County CWPP planning area. BLM, TNF, and CNF manage wildland fire to help reduce unnaturally high wildland fuel loads that contribute to catastrophic wildland fire and to help encourage the return of fire to a more natural role in fire-adapted ecosystems, to achieve ecosystem benefits, to reduce economic impacts, and to enhance public and firefighter safety.

The desired future condition of federal lands includes improving public and firefighter safety from wildland fire on public lands, using wildland fire as a management tool to achieve resource objectives, managing hazardous wildland fuels within and adjacent to the WUI, providing adaptive wildland fire response and suppression, and returning public lands to Condition Class I status. Federal lands in this condition class can carry wildfire without significant impacts on habitat components. Once this condition class is achieved, natural processes such as fire can be incorporated into long-term management practices to sustain habitat health. Current federal fire policy requires all wildland fires from unplanned ignitions to be managed for either protection objectives (wildfire) or resource benefit (wildland fire use). Under the current policy a single wildfire cannot be managed for both objectives concurrently (National Fire and Aviation Executive Board 2007; see Appendix F). The Lower Sonoran, Safford, and Tucson FOs and TNF and CNF adhere to federal policy when managing all unplanned wildfire ignitions on public lands within the WUI. Federal policy for reducing wildfires on public lands (that is, BLM and FS lands) is planned and administered locally through the BLM's FOs and the TNF's Catalina, Globe, and Mesa Districts. Under the proposed action described in the *Approved Arizona Statewide Land Use Plan Amendment for Fire, Fuels, and Air Quality Management and Decision Record* (USDI BLM 2004a), BLM-administered public lands are assigned one of two land use allocations for fire management: Allocation 1 includes areas suitable for wildland fire use for resource-management benefit, and Allocation 2 includes areas not suitable for wildland

fire use for resource benefit. With the exception of a small amount of desert shrub vegetation associations within the WUI, most of the WUI is classified as Allocation 1 lands.

The desired future condition of private lands in the WUI is for landowners to comply with Firewise standards recommended by the Core Teams or to meet home-ignition-zone landscaping or fire-safe landscaping recommended by the Pinal County CWPP fire departments and districts in compliance with local ordinances. Firewise (http://www.Firewise.org) is a national program that helps communities reduce wildfire risks and provides them with information about protecting themselves against catastrophic wildfires and mitigating losses from such fires. Within Arizona, the State Forester administers the Firewise certification program. Fire departments and districts and local governments in Pinal County would like to make this information available to their citizens and to encourage its application. Residential and other structures that comply with Firewise standards significantly reduce fire-ignition risks in a community as well as the potential for fires to spread to surrounding habitats. Additionally, structures that comply with Firewise recommendations are more likely to survive wildland fires that do spread into a community (Cohen 2008).

The Core Teams are aware that wildland fuel accumulations primarily associated with the invasion of woody species and nonnative grasses, together with community growth in the WUI, have produced areas at high risk from catastrophic wildfire. The Core Teams aspire to achieve restored, self-sustaining, biologically diverse habitats of mixed open space and developed areas that contribute to a quality of life demanded by Pinal County citizens. The Core Teams recognize that protection from catastrophic wildland fire requires collaboration and implementation through all levels of government and through an informed and motivated public. The Core Teams considered ecosystem restoration to the historical plant potential community, community protection, and public and firefighter safety while developing this CWPP (see Photo 1.2).

**Photo 1.2.** Wildland fire near private property in the Pinal County CWPP WUI

Financial commitments required to reduce the risk of catastrophic wildfire can be extensive for municipal, county, state, and federal governments, as well as for the small rural communities surrounded by public lands. Pinal County, CNF, TNF, and BLM have implemented wildland fuel mitigation projects within or near the WUI. Fire departments and districts have improved wildland fire suppression response and continue

public education and outreach programs concerning wildland fire threat and home-ignition-zone recommendations. Pinal County fire departments and districts maintain wildland fire response teams supported by various engines and support equipment including twenty-five type 1, two type 2, and two type 3 engines for structure protection, some of which are equipped with wildland hoses and equipment; eleven type 6 engines and five water tenders for wildland engine support; and various other specialized response vehicles to help suppress activities including portable weather stations and particulate-matter monitors. Additionally, the fire departments and districts have taken proactive measures to encourage willing property owners to reduce fire risk on private property (HFRA, Sec.103.d.2.B). Wildland fire response teams are composed of personnel with various levels of wildland firefighting training, including red-carded firefighters. The response teams are coordinating radio frequencies to improve communications between initial-attack and responding firefighting agencies and departments. Specially trained wildland fire response teams not only provide suppression response to brush fires but also provide community awareness programs and structural-fire risk assessments. The Core Teams, BLM, TNF, CNF, and collaborators are proposing additional wildland fuel treatments and wildland fire suppression enhancements and have been proactive in pursuing funding for wildland fire public outreach programs and fire-suppression training and equipment.

### D. Goals for the Pinal County CWPP

To reduce the risks to life and property from catastrophic wildland fire, the Core Teams have agreed on the following primary goals of the Pinal County CWPP:

- Improve fire prevention and suppression, emphasizing firefighter and public safety
- Reduce hazardous fuels, emphasizing public and private property protection
- Restore forest, rangeland, and riparian health
- Promote community involvement and provide for community protection
- Recommend measures to reduce structural ignitability in the WUI
- Encourage economic development in the communities from vegetative treatments
- Promote development of wildfire emergency evacuation and communication plans
- Integrate use of the CWPP with surrounding community and agency fire management plans

### E. Planning Process

During initial analysis, and to aid the overall development of this plan, the Core Teams reviewed the following documents and studies:

- “Urban Wildland Interface Communities within the Vicinity of Federal Lands That Are at High Risk from Wildfire,” *Federal Register* Vol. 66, Nos. 3 and 160 (USDA and USDI 2001a, 2001b)
- *National Fire Plan* (USDA FS and USDI BLM 2004b)
- *Healthy Forests: An Initiative for Wildfire Prevention and Stronger Communities* (Presidential Policy 2002)
- HFRA

- *The Healthy Forests Initiative and Healthy Forests Restoration Act: Interim Field Guide* (USDA FS and USDI BLM 2004a)
- *Preparing a Community Wildfire Protection Plan: A Handbook for Wildland-Urban Interface Communities* (Communities Committee et al. 2004)
- *Field Guidance: Identifying and Prioritizing Communities at Risk* (National Association of State Foresters 2003)
- *Arizona Wildland Urban Interface Assessment* (Arizona State Forester 2004)
- *Arizona-Identified Communities at Risk* (Arizona State Forester 2007a)
- *Identifying Arizona's Wildland/Urban Interface Communities at Risk: A Guide for State and Federal Land Managers* (Arizona State Forester 2007b)
- *Statewide Strategy for Restoring Arizona's Forests* (Governor's Forest Health Councils 2007)
- *A Collaborative Approach for Reducing Wildland Fire Risks to Communities and the Environment: 10-Year Comprehensive Strategy Implementation Plan* (USDA FS and USDI BLM 2002)
- *Approved Arizona Statewide Land Use Plan Amendment for Fire, Fuels, and Air Quality Management and Decision Record* (USDI BLM 2004a)
- *Coronado National Forest Land and Resource Management Plan* (USDA FS 2005a)
- *Wildland Fire Amendment to the Coronado National Forest Land and Resource Management Plan* (USDA FS 2005b)
- *Wildland Fire Use Implementation Procedures Reference Guide* (USDI and USDA 2005)
- *Wildland Fire Suppression (Including Wildland Fire Use) and Rehabilitation in Riparian and Aquatic Habitats (RA)* (USDI BLM 2004b)
- *Southern Arizona Buffelgrass Strategic Plan: A Regional Guide for Control, Mitigation, and Restoration* (Rogstad 2008)
- *Oracle Community Wildfire Protection Plan* (Oracle Fire District 2008)

Action recommendations for at-risk areas within the Pinal County CWPP WUI boundaries have been developed as part of this planning process. Treatments for wildland vegetative fuels and additional wildland fire mitigation measures are recommended to be implemented in specific time frames and with associated monitoring to determine and document measurable outcomes. Successful implementation of the Pinal County CWPP will require collaboration by fire departments and districts, governments, resource-management agencies, and the private sector. The cooperating agencies must develop processes and systems that ensure recommended actions of the Pinal County CWPP comply with applicable local, state, and federal environmental regulations. The dedication of the Core Teams and collaborators in implementing the Pinal County CWPP assures that all agencies, groups, and individuals involved will develop any additional formal agreements necessary to ensure the Pinal County CWPP's timely implementation, monitoring, and reporting. The Core Teams were formed not only to meet collaborative requirements of HFRA but also to represent all of the different interests of the Pinal County communities, with all parties being involved and being committed to the development and implementation of the Pinal County CWPP.

# II. Pinal County CWPP COMMUNITY ASSESSMENT AND ANALYSIS

The community risk assessment is an analysis of the potential for catastrophic wildland fire to Pinal County communities and lands within the WUI identified by the Core Teams. This risk analysis incorporates the current condition class, wildfire fuel hazards, risk of ignition, wildfire occurrence, and at-risk community values. Local preparedness and protection capabilities are also factors that contribute to the delineation of areas of concern. The Core Teams have reviewed the Arizona State Forester's *Identifying Arizona's Wildland/Urban Interface Communities at Risk: A Guide for State and Federal Land Managers* (2007b) to ensure that the Pinal County CWPP is compatible with and complementary to statewide CWPP planning efforts. The Core Teams have included all risk factors required by the Arizona State Forester in the analysis of this CWPP. The areas of concern for wildland fuel hazards, risk of ignition and wildfire occurrence, and loss of community values are evaluated to determine areas of highest wildland fire risk.

The Pinal County CWPP planning area includes all of Pinal County, including tribal trust lands, divided into two analysis areas: one for the eastern portion of the county and one for the western portion of the county (Figure 2.1). Tribal trust lands of the Ak-Chin Indian Community, Gila River Indian Community, and the San Carlos and the Tohono O'odham Nations are included in the total acreage of the WUI. The Pinal County CWPP comprises 1,986,077 acres of land (Table 2.1).

**Table 2.1.** Land management within the WUI

| Ownership type | Total acres | % of total |
|---|---|---|
| ASLD | 597,470 | 30.0 |
| Private | 816,724 | 41.0 |
| BLM | 167,957 | 8.5 |
| TNF | 55,367 | 2.8 |
| CNF | 1,341 | <0.01 |
| Gila River Indian Community | 277,399 | 14.0 |
| Ak-Chin Indian Community | 21,061 | 1.0 |
| San Carlos Indian Nation | 841 | <0.01 |
| Tohono O'odham Indian Nation | 11,166 | 0.6 |
| Central Arizona Project | 11,159 | 0.6 |
| Military Reservation | 7,101 | 0.4 |
| San Tan Mountain Regional Park | 10,218 | 0.5 |
| Lost Dutchman State Park | 288 | <0.01 |
| Picacho Peak State Park | 3,375 | 0.2 |
| Boyce Thompson SW Arboretum | 81 | <0.01 |
| Oracle State Park | 3981 | 0.2 |
| Casa Grande Ruins National Monument | 481 | <0.01 |
| Bureau of Reclamation | 67 | <0.01 |
| **Total** | 1,986,077 | 100* |

*Actual total may not add to 100% because of rounding.

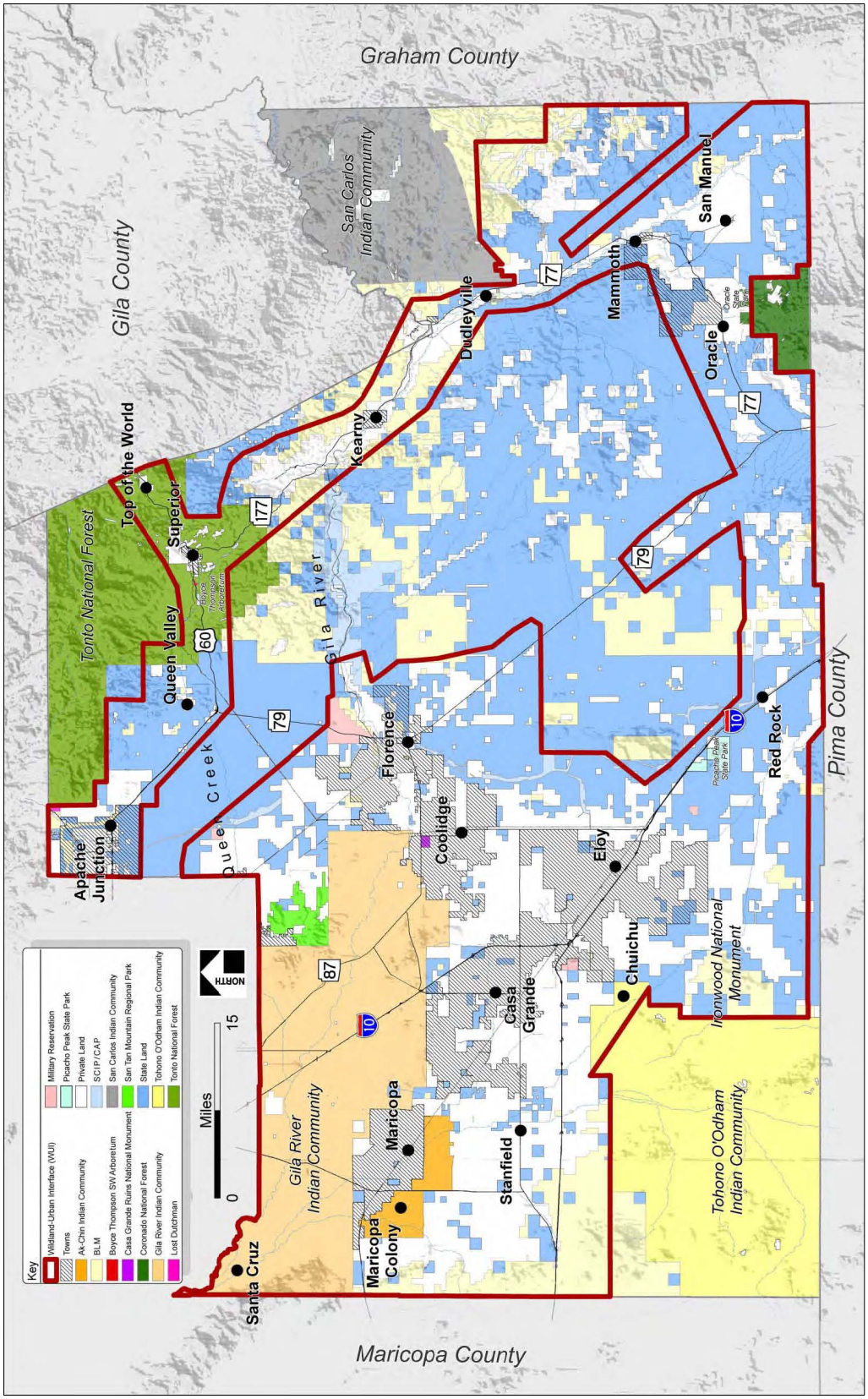



**Figure 2.1.** Pinal County CWPP WUI area

The Pinal County CWPP planning area primarily includes BLM (8.5 percent), CNF (0.01 percent), TNF (2.8 percent), ASLD (30 percent), and private (41 percent) lands.

Primary land ownership in the Pinal County CWPP planning area is a mosaic of privately owned lands and lands administered by ASLD, TNF, and BLM (Table 2.1 and Figure 2.1). Much of the land within the Pinal County CWPP planning area is considered rural with minimal development.

Of the publicly owned lands within the WUI, ASLD is the largest land manager with 597,470 acres, or 30 percent, of the WUI, and lands are located throughout the WUI. State lands were established in 1912 under the terms of the Arizona Enabling Act. With statehood, Arizona was granted ownership of four sections per township. The ASLD manages these State Trust lands to produce revenue for the Arizona State Trust beneficiaries, including the state's school system. Within the Pinal County CWPP area, State Trust lands are managed primarily for recreation, natural resource protection, and livestock grazing.

Of the remaining publicly owned lands within the WUI, BLM, TNF, and CNF lands compose 224,665 acres, or approximately 11 percent, of the WUI. These federal lands provide extensive and popular hiking, hunting, and recreational areas within or adjacent to the WUI. The potential for escaped campfires or the need to evacuate camping areas in the event of a wildfire warrants including these lands in the Pinal County CWPP area. Additionally, 67 acres of Bureau of Reclamation lands have been withdrawn to the US Army Corps of Engineers for the Whitlow Ranch Flood Control Basin.

Private land within the WUI composes the largest ownership within the WUI at 816,724 acres, or roughly 41 percent, of the WUI. Private lands are mostly clustered near the communities, with some scattered private inholdings located throughout the WUI. The municipalities of Florence, Coolidge, Apache Junction, Queen Creek, Eloy, Superior, Casa Grande, Mammoth, Maricopa, and Kearny and the communities of Queen Valley, Dudleyville, Stanfield, Picacho, Thunderbird Ranch, Oracle Junction/Saddlebrook, and Oracle contain the majority of private land acreage within the WUI. The Pinal County CWPP WUI includes over 299,246 residents and 137,410 housing units (US Census Bureau 2008) and associated structures. Commercial structures are clustered along state and federal highways and community centers, and they are assumed to remain as the principal commercial corridors within the Pinal County at-risk communities. Pinal County has experienced considerable growth in population and housing during the recent decade. The population estimate for Pinal County was reported as approximately 180,000, with slightly over 81,000 housing units, in 2000—this represents a 60 percent increase in housing units since the 2000 census. Growth is anticipated to continue in both urban and rural settings in Pinal County. Pinal County and the Core Teams recognize that the WUI will continue to grow and that fire departments and districts will be challenged to provide fire response services to an increasing number of constituents.

The Pinal County CWPP planning area boundary is identified in Figure 2.1 and is included within the *Statewide Strategy for Restoring Arizona's Forests* (Governor's Forest Health Councils, State of Arizona, 2007), which distinguishes nine forested landscapes. One of these identified forested landscapes, the Sky Islands, occurs in Pinal County.

The Sky Islands region is located at the confluence of four major bioregions—the southern Rocky Mountains, the northern Sierra Madre Mountains, the Sonoran Desert, and the Chihuahuan Desert. The

Sky Islands region of the *Statewide Strategy* is circumscribed by the Gila Mountains to the north, the Baboquivari Mountains to the west, and the Mexican border to the south. Vegetation ranges from madrean encinal to oak woodlands at elevations normally above 3,600 feet to desert shrublands at lower elevations. The Sky Islands landscape is mostly rural. The overall population density is typically less than five people per square mile, except for urban and suburban areas. Population in the Sky Islands region has been increasing steadily during the last five years. The mild climate and comparatively low cost of living draws large numbers of retirees and larger-community commuters from other parts of the state. Due to high levels of topographical complexity and gradient within the portions of the Sky Islands landscape within the Pinal County CWPP WUI, fire characteristics are variable. Single fires can cross multiple vegetation associations. Unnatural high fuel loads and drought continue to contribute to high wildland fire risk. Recommendations for "Future Restoration Needs" (Governor's Forest Health Councils State of Arizona 2007 p115) of the Sky Islands landscape applicable to the Pinal County CWPP include (1) conducting educational outreach to stakeholders that will highlight the ecological and socioeconomic benefits of ecological restoration, (2) providing incentives and assistance for restoration of privately owned forests (or lands within the Pinal County CWPP), (3) integrating restoration planning with long-term planning and zoning processes, which will require outreach and education to planning and zoning commissions, (4) encouraging Firewise landscaping and building in communities, and (5) encouraging the restoration-based harvesting of firewood as opposed to importing firewood from Mexico. The Core Teams support the recommendations within the *Statewide Strategy for Restoring Arizona's Forests* and produced the Pinal County CWPP to be complementary to those assessments and recommendations.

The climate of Pinal County is varied—ranging from semiarid communities with relatively low precipitation, low humidity, and high summer temperatures to communities associated with the Gila and San Pedro rivers and to areas of oak woodlands with mild summers and cool winters. Precipitation averages from 3.5 to 20.0 inches per year depending on elevation and occurs primarily during two rainy periods—summer rainfall, which usually occurs in local torrential convection showers, and winter rainfall, which is usually slow and can occur over several days (Arizona Department of Commerce 2007).

The planning area includes three rivers: the San Pedro, the Santa Cruz, and the Gila. The San Pedro River flows north from the Mexican state of Sonora into Arizona to join the Gila River near Winkelman. It is one of the last few large undammed rivers in the Southwest. The San Pedro River supports nearly two-thirds of the avian diversity in the United States; about 100 species of birds breed around the river, and an additional 250 species use the corridor for migration and winter range. It also provides habitat for 80 species of mammals, including the elusive jaguar (Photo 2.1).

The Santa Cruz River (Photo 2.2) has its headwaters in the high intermontane grasslands of the San Rafael Valley just north of the US-Mexican border. It flows southward into Mexico, turns westward, and reenters the United States just east of Nogales and continues northward past Tucson to the Santa Cruz Flats just south of Casa Grande and the Gila River. The Santa Cruz River is usually a dry riverbed throughout much of the year, unless the area receives significant rainfall.

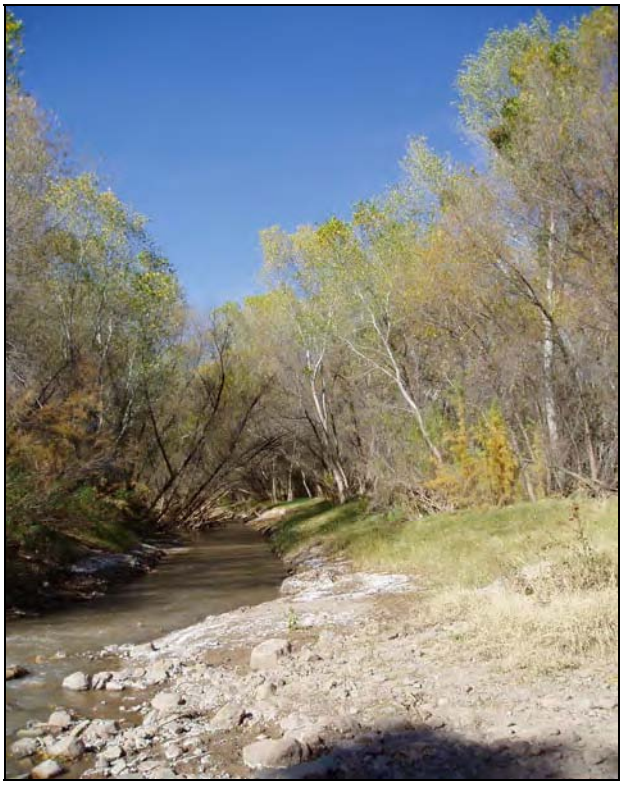


**Photo 2.1.** San Pedro River at Dudleyville

**Photo 2.2.** Santa Cruz River at I-8

The Gila River (Photo 2.3) is a tributary of the Colorado River. It begins in western New Mexico, flows southwest and westward into Arizona, emerges from the mountains into the valley southeast of Phoenix where it crosses the Gila River Indian Reservation as an intermittent stream, flows westward and southward past Gila Bend, and joins the Colorado River near Yuma, Arizona. It is one of the largest desert rivers in the world. The western portion of the Gila River is largely a dry river bed in part due to irrigation and municipal water uses, though it can carry massive volumes of water after rain storms.

**Photo 2.3.** Gila River at I-10

The majority of federally managed public lands within the Pinal County CWPP are administered by BLM. In accordance with the *Approved Arizona Statewide Land Use Plan Amendment for Fire, Fuels, and Air Quality Management and Decision Record* (USDI BLM 2004a and USDI BLM 2004b), BLM-administered public lands are assigned to one of two land use allocations for fire management. Allocation 1 lands include areas where fire is desired and there are few or no constraints for its use. Wildland fire may be used to achieve resource objectives, such as improved watershed or wildlife habitat. Where fuel loading is high and conditions are not initially suitable for wildland fire, fuel loads may be reduced by mechanical, chemical, or biological means to acceptable levels and to meet resource objectives. Allocation 2 lands include areas where mitigation and suppression are required to prevent direct threats to life or property. It also includes areas where fire never played a large role in ecosystem management and where unplanned ignitions would have negative effects on resources. In these areas BLM will implement programs to reduce unwanted ignitions and emphasize prevention, detection, and rapid suppression. In addition to both land use allocations, BLM will undertake education, enforcement, and administrative fire-prevention measures to reduce human-caused fire.

National forest lands within the analysis areas fall under four fire management units (FMUs): FMU 1–Desert, FMU 4–Woodland Brush, FMU 5–Wilderness, and FMU 6–WUI9 (USDA FS 2005b) and USDA FS 2006).

FMU 1 consists of the Sonoran Desert and is represented by National Fire Danger Rating System (NFDRS) Fuel Model T (See Appendix B for NFDRS fuel model definitions). Areas that have burned at a high intensity have been converted from Sonoran Desert to desert grasslands composed of nonnative grasses. Fire intensities from the nonnative species have compounded the problem. The two species that classify this FMU are the saguaro cactus and the palo verde tree. Wildfire will be managed consistent with resource objectives. Capital investments within these areas will be protected from fire. Actions taken will be consistent with the appropriate management response (AMR) for this area. Wildfires, or portions of

wildfires, that adversely affect forest resources, endanger public safety, or have a potential to damage private lands will be suppressed. Suppression efforts will be accomplished with minimal ground disturbance and least cost suppression methods will be initiated when possible (that is, using existing natural or human-made features as control lines).

FMU 4 consists of pinyon pine, juniper, and chaparral and is represented by NFDRS Fuel Model B. Much of this FMU contains a thick overstory and shrubby understory. Many of the chaparral stands contain old, decadent components. In areas where the pinyon pines and junipers are less dense, there is often a dense layer of herbaceous vegetation. Wildfires will be managed consistent with resource objectives. Wildland fire not meeting management objectives will receive an AMR. Fire management objectives for this area include providing a mosaic of age classes within the total type, which will provide for a mix of successional stages, and allowing fire to resume its natural ecological role within ecosystems. Wildfires, or portions of wildfires, will be suppressed when they adversely affect forest resources, endanger public safety, or have a potential to damage significant capital investments.

FMU 5 consists of the Superstition Wilderness areas on the TNF and is represented mostly by NFDRS Fuel Models B and T and partly by Fuel Model U. This FMU contains fuel characteristics that are found in all the other FMUs, at all elevations, and contains much of the TNF's various vegetation types. Wildfires occurring within this FMU will receive an AMR and be managed consistent with Wilderness resource objectives. Wildfires may be allowed to burn, to function in their natural ecological role, and to reduce unnatural fuel hazards as identified in the Forest Service Manual and approved Wilderness Implementation Plan.

FMU 6 consists of national forest lands adjacent to private lands with developments and most infrastructure sites on national forest lands. This land is defined by a 0.5-mile buffer on each side of a structure or private boundary. Wildfires occurring within this FMU will be immediately suppressed at the smallest acreage possible. Both mechanical treatment and prescribed fire will be used to reduce potential wildfire intensity.

### A. Fire Regime and Condition Class

Before European settlement of North America, fire played a natural (historical) role in the landscape. Five historical fire regimes have been identified based on the average number of years between fires (fire frequency) combined with the severity (amount of overstory replacement) of fire on the dominant overstory vegetation (Table 2.2).

**Table 2.2.** Fire regime information

| | Frequency | Severity[a] |
|---|---|---|
| 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 |

*Source*: Schmidt et al. 2002.

[a]Low = less than 75% of the dominant overstory vegetation replaced. High = greater than 75% of the dominant overstory vegetation replaced (stand replacement).

The condition class of wildland habitats describes the degree to which the current fire regime has been altered from its historical range, the risk of losing key ecosystem components, and the vegetative attribute changes from historical conditions. The following descriptions of condition classes are provided by the Arizona State Forester (2007b:3):

> Condition Class 1:
>
> Fire regimes are within a historical range, and the risk of losing key ecosystem components is low. Vegetation attributes (species composition and structure) are intact and functioning within the historical range.
>
> Condition Class 2:
>
> Fire regimes have been moderately altered from their historical range. The risk of losing key ecosystem components is moderate. Fire frequencies have departed from historical frequencies by one or more return intervals (either increased or decreased). This results in moderate changes to one or more of the following: fire size, intensity and severity, and landscape patterns. Vegetation attributes have been moderately altered from their historical range.
>
> Condition Class 3:
>
> Fire regimes have been significantly altered from their historical range. The risk of losing key ecosystem components is high. Fire frequencies have departed from historical frequencies by multiple return intervals. This results in dramatic changes to one or more of the following: fire size, intensity, severity, and landscape patterns. Vegetation attributes have been significantly altered from their historical range.

The Pinal County WUI covers 1,986,077 acres, including 45,817 acres of land classified as developed and low-density open space and barren landscape (2% of WUI acres) and 308,924 acres of agricultural land (16% of WUI acres). The WUI includes 1,233,804 acres (62% of WUI acres) of Fire Regime Condition Class (FRCC) I lands, 132,592 acres (7% of WUI acres) of FRCC II lands, and 264,940 acres (13% of WUI acres) of FRCC III lands, as described in *Development of Coarse-Scale Spatial Data for Wildland Fire and Fuel Management* (Schmidt et al. 2002).

Because condition-class categories are based on coarse-scale data that are intended to support national-level planning, any interpolation of national data for localized conditions may not be valid (FRCC Interagency Working Group 2005b) due to invasive perennial and annual grasses, exotic forbs, and woody-species encroachment in native habitats altering local fire regimes. Therefore, local agencies are asked to provide data for localized vegetative conditions that reflect an accurate, current FRCC (USDA FS 2000). The amount of land disturbance causing the growth of flammable annuals (pigweed, Asian mustard, and thistles) and invasive grasses such as buffelgrass in affected WUI areas can rapidly alter the potential of a vegetation association to support unwanted wildland fire. In addition, increasing woody-species invasions, especially saltcedar within the riparian corridors, indicate that the perennial and ephemeral riparian, upland, and desert grassland habitats no longer conform to components of Condition Class 1 lands. Invasive nonnative plants have severe ecological impacts on vegetative structure

(Arizona Wildlands Invasive Plant Working Group [AZ-WIPWG] 2005). Therefore, local conditions indicate that the majority of wildland habitats within the WUI actually fall within Condition Classes 2 and 3 (Photo 2.4).

**Photo 2.4.** Wildfire in saltcedar-invaded riparian habitat

As reported in the *Statewide Strategy for Restoring Arizona's Forests* (Governor's Forest Health Councils 2007:46), the majority of the Sky Islands landscape (92%) has been classified as Condition Classes 2 and 3 in which there is a "moderate to high risk of losing key ecosystem components to fire." Within the Sky Islands landscape, fire exclusion combined with recent drought has exacerbated heavy fuel loading in some areas that in turn increases the probability of uncharacteristic wildfire.

The desired future condition of federal land within the Pinal County CWPP area is to return to or maintain wildland within Condition Class 1, as described in *Fire Regime and Condition Class (FRCC) Interagency Handbook Reference Conditions* (2005a):

> Open park-like savanna grassland, or woodland, or shrub structures maintained by frequent surface or mixed severity fires . . . Surface fires typically burn through the understory removing fire-intolerant species and small-size classes and 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, postfire grassland, savannah woodlands, or open shrub patches by leaving greater than 25 percent of the upper layer (generally less than 40 hectares [100 acres]). Interval[s] can range up to 50 [years] in systems with high temporal variability.

Desired future conditions for Great Basin Pinyon-Juniper Woodland, Lower Sonoran Desert Scrub, Montane Conifer Forest, and Riparian habitats, as described in the *Approved Arizona Statewide Land Use Plan Amendment for Fire, Fuels, and Air Quality Management and Decision Record* (USDI BLM 2004a: 2–3), are as follows:

Great Basin Pinyon-Juniper Woodland habitat:

> Annual weeds such as cheatgrass are controlled, ladder fuels and downed woody debris are limited or not present, and juniper and piñon pine tree densities and cover occur at their historic range of variation.

Lower Sonoran Desert Scrub habitat:

> An adequate cover of and mix of natural plant species that have good vigor. Wildland fire would control or reduce the exotic annual weeds such as red brome and to limit woody vegetation to non-hazardous levels.

Montane Conifer Forest habitat:

> Dog-hair thickets are controlled, ladder fuels and downed woody debris are limited or not present, a high percentage of large trees are maintained, and tree stand vigor is maintained through controlled fire and mechanical treatments.

Riparian habitat:

> Annual weed cover and density is controlled and ladder fuels and downed woody debris are limited or not present. Disturbances that can potentially reduce natural vegetation cover and vigor are managed to maintain cover and mix of native riparian plant species.

### B. Fuel Hazards

The arrangement of vegetative fuel, relative flammability, and potential of vegetation to support wildland fire varies throughout the WUI. Wildland fuel hazards depend on a specific composition, type, arrangement, or condition of vegetation such that if the fuel were ignited, an at-risk community or its infrastructure could be threatened. Table 2.3 identifies the total amount of land in the WUI that was evaluated for overall wildland fire risk because of increased wildland vegetative fuel hazards. Historically, fire played an important role in keeping woody species in check and light ground fuels low (USDI BLM 2004b:3–8; Gori and Enquist 2003). However, with the suppression of natural wildfires within the last century, fire return intervals have increased, and invasions of desert grasslands by woody shrub, including mesquite and juniper species, and nonnative grasses, such as cheat grass, red brome, and Mediterranean grass, have altered native vegetative associations. The Core Teams reviewed vegetation associations within the WUI that were identified and mapped using Southwest Regional Gap Analysis Project (SWReGAP) data (USGS 2005; NatureServe 2004) (Figure 2.2). These datasets provide the level of landscape description and vegetative landcover detail necessary for aligning wildland fuel flammability with existing vegetation. The major distinguishing types for each Pinal County CWPP vegetation association were field verified.

**Table 2.3.** Fuel model, fire-danger ratings, and intensity levels on vegetation associations in the WUI

| Fuel type | Vegetation association | Wildfire risk rating[a] | Anderson fuel model | Fire-danger rating model[b] | Flame length (ft) | Fire intensity level | Rate of spread ft/hr (ch/hr) | Fire behavior fuel model | Flame length (ft)—low dead fuel moisture | FIL | Rate of spread ft/hr (ch/hr)—low dead fuel moisture | Acres (%) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Desert shrub-scrub** | Chihuahuan creosotebush, mixed desert, and thorn scrub | L | 1,2 | T | 4–6 | 4 | 2310–5150 (35–78) | GR1<br>GR2 | 0.5–1.7<br>1.0–8.0 | GR1: 1<br>GR2: 1–4 | 0–990 (0–15)<br>0–7920 (0–15) | 60,142 (3) |
| | Chihuahuan mixed salt desert scrub | L | 1,2 | T | 4-6 | 4 | 2310–5150 (35-78) | GR1, GR2, or SH1 | GR1, 0.5–1.7<br>GR2, 1.0–8.0<br>SH1, 0.2–0.7 | GR1: 1<br>GR2: 1–4<br>SH1: 1 | GR1, 0–990 (0–15)<br>GR2, 0–7920 (0–120)<br>SH1, 6.6–112.2 (0.1–1.7) | 19,001 (1) |
| | Sonoran mid-elevation desert scrub | L | 2,6 | F and T | 6 | 3 | 2110–2310 (32–35) | GR1, GR2, or SH1 | GR1, 0.5–1.7<br>GR2, 1.0–8.0<br>SH1, 0.2–0.7 | GR1: 1<br>GR2: 1–4<br>SH1: 1 | GR1, 0–990 (0–15)<br>GR2, 0–7920 (0–120)<br>SH1, 6.6–112.2 (0.1–1.7) | 42,066 (2) |
| | Sonoran paloverde-mixed cacti desert scrub | M | 1,3 | L and T | 4–6 | 3 | 2310–5150 (35–78) | GR1 or GR2 | GR1, 0.5–1.7<br>GR2, 1.0–8.0 | GR1, 1<br>GR2, 1–4 | GR1, 0–990 (0–15)<br>GR2, 0–7920 (0–120) | 662,648 (33) |

*Continued*

**Table 2.3.** Fuel model, fire-danger ratings, and intensity levels on vegetation associations in the WUI

| Fuel type | Vegetation association | Wildfire risk rating[a] | Anderson fuel model | Fire-danger rating model[b] | Flame length (ft) | Fire intensity level | Rate of spread ft/hr (ch/hr) | Fire behavior fuel model | Flame length (ft)—low dead fuel moisture | FIL | Rate of spread ft/hr (ch/hr)—low dead fuel moisture | Acres (%) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Sonora-Mohave creosotebush-white bursage desert scrub | L | 1 | L and T | 4–6 | 3 | 2110–5150 (32–78) | GR1 or SH1 | GR1, 0.5–1.7<br>SH1, 0.2–0.7 | GR1, 1<br>SH1, 1 | GR1, 0–990 (0–15)<br>SH1, 6.6–112.2 (0.1–1.7) | 400,427 (20) |
| | Sonora-Mohave mixed salt desert scrub | L | 1,2 | L and T | 4–6 | 3 | 2310–5150 (35–78) | GR1 or GR2 | GR1, 0.5–1.7<br>GR2, 1.0–8.0 | GR1, 1<br>GR2, 1–4 | GR1, 0–990 (0–15)<br>GR2, 0–7920 (0–120) | 118,131 (6) |
| **Shrublands** | Apacherian–Chihuahuan mesquite upland scrub | M | 1,3 | B and T | 4–12 | 6 | 5150–6860 (78–104) | GR1, GS1, SH1, SH2, or SH5 | GR1, 0.5–1.7<br>GS1, 1.0– 6.0<br>SH1, 0.2–0.7<br>SH2, 1.0–4.5<br>SH5, 4.0–25.0+ | GR1, 1<br>GS1, 1–3<br>SH1, 1<br>SH2, 1–3<br>SH5, 2–6 | GR1, 0–990 (0–15)<br>GS1, 0–3960 (0–60)<br>SH1, 6.6–112.2 (0.1–1.7)<br>SH2, 0–1188 (0–18)<br>SH5, 0–16,500 (0–250+) | 115,442 (6) |

*Continued*

**Table 2.3.** Fuel model, fire-danger ratings, and intensity levels on vegetation associations in the WUI

| Fuel type | Vegetation association | Wildfire risk rating[a] | Anderson fuel model | Fire-danger rating model[b] | Flame length (ft) | Fire intensity level | Rate of spread ft/hr (ch/hr) | Fire behavior fuel model | Flame length (ft)—low dead fuel moisture | FIL | Rate of spread ft/hr (ch/hr)—low dead fuel moisture | Acres (%) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Grasslands** | Apacherian-Chihuahuan piedmont semi-desert grassland and steppe | L | 1,2 | F and T | 4–6 | 3 | 2310–5150 (35–78) | GS1, GR1 or GR2 | GS1, 1.0–6.0<br>GR1, 0.5–1.7<br>GR2, 1.0–8.0 | GS1, 1–3<br>GR1, 1<br>GR2, 1–4 | GS1, 0–3960 (0–60)<br>GR1, 0–990 (0–15)<br>GR2, 0–7920 (0–120) | 9,907 (0) |
| **Woodlands** | Mogollon Chaparral | H | 4, 6 | B and T | 6–19 | 4–6 | 2110–4950 (32–75) | SH2 or SH5 | SH2, 1.0–4.5<br>SH5, 4.0–25.0+ | SH2, 1–3<br>SH5, 2–6 | SH2, 0–1188 (0–18)<br>SH5, 0–16,500 (0–250+) | 30,203 (2) |
| | Madrean Encinal | H | 2,9 | E and T | 2.6–6 | 4–6 | 495–2310 (7.5–35) | GR2, GR4, or TL1 | GR2, 1.0–8.0<br>GR4, 2.0–21+<br>TL1, 0.25–0.5 | GR2, 1–4<br>GR4, 1–6<br>TL1, 1 | GR2, 0–7920 (0–120)<br>GR4, 0–33,000 (0–500+)<br>TL1, 6.6–46.2 (0.1–0.7) | 27,550 (1) |
| **Deciduous Southwest Riparian** | North American Warm Desert Riparian Mesquite Bosque | H | 6,9 | E and T | 2.6–6 | 6 | 495–2110 (7.5–32) | SH2, SH5, or TL2 | SH2, 1.0–4.5<br>SH5, 4.0–25.0+<br>TL2, 0.3–1.0 | SH2, 1–3<br>SH5, 2–6<br>TL2, 1 | SH2, 0–1188 (0–18)<br>SH5, 0–16,500 (0–250+)<br>TL2, 13.2–132 (0.2–2.0) | 27,139 (1) |

*Continued*

**Table 2.3.** Fuel model, fire-danger ratings, and intensity levels on vegetation associations in the WUI

| Fuel type | Vegetation association | Wildfire risk rating[a] | Anderson fuel model | Fire-danger rating model[b] | Flame length (ft) | Fire intensity level | Rate of spread ft/hr (ch/hr) | Fire behavior fuel model | Flame length (ft)—low dead fuel moisture | FIL | Rate of spread ft/hr (ch/hr)—low dead fuel moisture | Acres (%) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Other** | Agriculture | L | NA | NA | NA | NA | NA | NB3 | NA | NA | NA | 359,120 (18) |
| | Developed, Open Space—Low Intensity | L | NA | NA | NA | NA | NA | NB1 | NA | NA | NA | 56,301 (3) |
| | Developed, Medium—High Intensity | L | NA | NA | NA | NA | NA | NB1 | NA | NA | NA | 39,268 (2) |
| | Colorado plateau mixed bedrock canyon and tableland | L | NA | NA | NA | NA | NA | NB9 | NA | NA | NA | 596 (0) |
| | North American warm desert bedrock cliff and outcrop | L | NA | NA | NA | NA | NA | NB9 | NA | NA | NA | 737 (0) |
| | Recently mined or quarried | L | NA | NA | NA | NA | NA | NB9 | NA | NA | NA | 17,397 (1) |
| | | | | | | | | | | | **Total** | 1,986,077 |

*Source:* National Fire Danger Rating System (USDA FS 1978; Burgan 1988).

[a]L = low, M = moderate, H = high, NA = not applicable.

[b]See Appendix B for the National Fire Danger Rating System definitions.

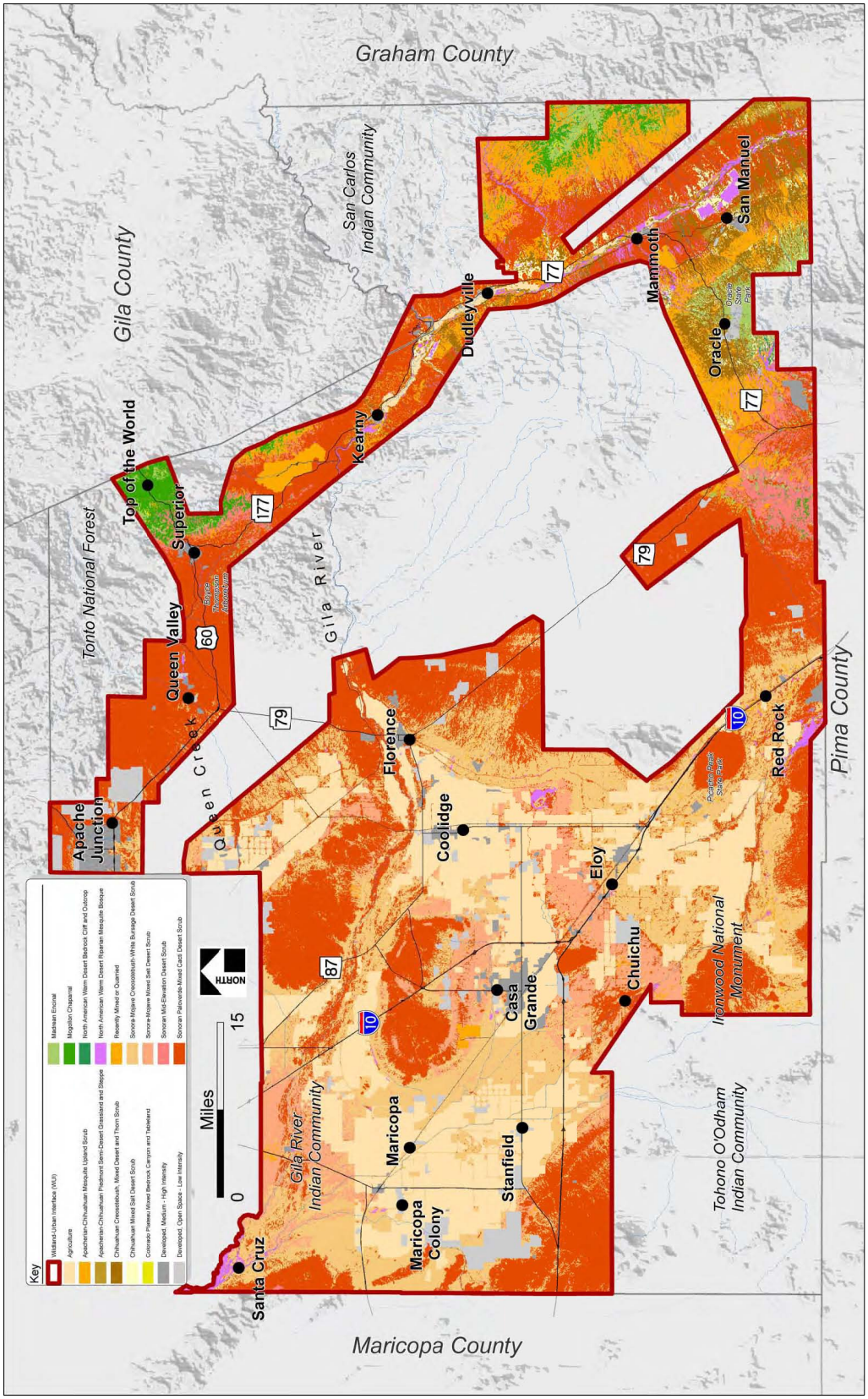



**Figure 2.2.** Pinal County CWPP vegetation associations

The existing arrangement and flammability of vegetation associations largely determine wildland fire behavior. Flammability for the Pinal County WUI is mapped in Figure 2.3. The Core Teams and collaborators identified areas at risk from wildland fire by evaluating vegetative fuels on federal and nonfederal land in the WUI through spatial analysis using geographic information system (GIS) technology in a series of overlays. For the WUI, the vegetation type, density, and distribution were analyzed to help categorize areas at highest risk for fire intensity and spread from wildland fuels.

Vegetative data for predicting wildfire behavior was quantified by developing descriptions of associated fuel properties that are described as fuel models. The fuel model (as described by Anderson 1982) and vegetation fuel fire-risk rating within the Pinal County CWPP WUI are shown in Table 2.3. As described by the Arizona State Forester (2007b:1),

> not all structures and/or communities that reside in an "interface" area are at significant risk from wildland fire. It is a combination of factors, including the composition and density of vegetative fuels, extreme weather conditions, topography, density of structures, and response capability that determines the relative risk to an interface community. The criteria listed below are intended to assist interagency teams at the state level in identifying the communities within their jurisdiction that are at significant risk from wildland fire. The application of these risk factors should allow for greater nationwide consistency in determining the need and priorities for Federal projects and funding.

The Core Teams reviewed the fire behavior potential in the WUI and determined that the risk classification is consistent with Situations 1, 2, and 3 as described by the Arizona State Forester (2007b:1–2):

> Risk Factor 1: Fire Behavior Potential
>
> Situation 1: In these communities, continuous fuels are in close proximity to structures. The composition of surrounding fuels is conducive to crown fires or high intensity surface fires. Likely conditions include steep slopes, predominantly south aspects, dense fuels, heavy duff, prevailing wind exposure and/or ladder fuels that reduce fire fighting effectiveness. There is a history of large fire and/or high fire occurrence.
>
> Situation 2: In these communities, intermittent fuels are in proximity to structures. Likely conditions include moderate slopes and/or rolling terrain, broken moderate fuels, and some ladder fuels. The composition of surrounding fuels is conducive to torching, spotting, and/or moderate intensity surface fires. These conditions may lead to moderate fire fighting effectiveness. There is a history of some large fires and/or moderate fire occurrence.
>
> Situation 3: In these communities, fine and/or sparse fuels surround structures. There is infrequent wind exposure and flat terrain to gently rolling terrain. The composition of surrounding fuels is conducive to low intensity surface fires. Fire fighting generally is highly effective. There is no large fire history and/or low fire occurrence.

Pinal County is composed of four major ecological range sites (Natural Resources Conservation Service [NRCS] 2007). Slope varies dramatically across the WUI with slope categories composed of valley floors with slope ranges of 0 to 3 percent, and 1 to 8 percent, with slope categories ranging from 5 to 45 percent and 5 to 60 percent in foothill and mountain habitats.

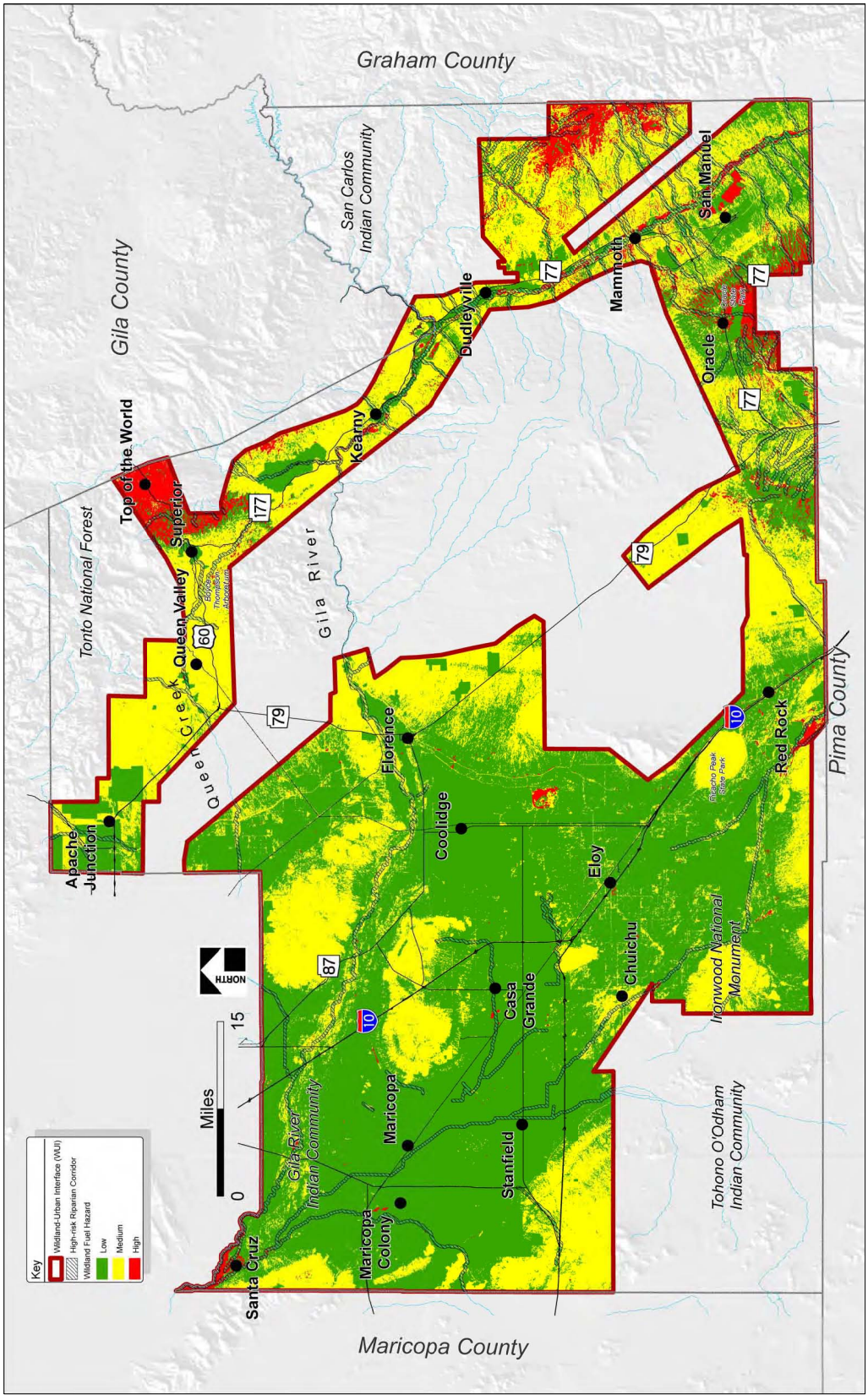



**Figure 2.3.** Pinal County CWPP flammability

Vegetative production ranges from over 4,000 lb/acre in highest-elevation sites in the >12-inch precipitation zone during favorable precipitation years to <50 lb/acre in lower desertscrub–mudstone hills range sites in the <7-inch precipitation zone during unfavorable precipitation years. Precipitation ranges from 7 to 14 inches annually, with a winter-summer rainfall ratio of 60:40. Warm-season rains (July–September) originate in the Gulf of Mexico and are usually brief and intense. Cool-season rains (December–March) originating in the Pacific Ocean are generally frontal, widespread, long, and less intense. May and June are the driest months of the year, with many natural fire ignitions occurring before the monsoon rains. Humidity is generally low, with mostly mild winters and hot summers in lower elevations to mild summers and cold winters in higher elevations. During May and June temperatures can exceed 100 degrees Fahrenheit. Cool-season vegetation growth begins in early spring and matures in early summer. Warm-season vegetation initiates growth after the summer rains and may remain green throughout the year in lower elevations.

The WUI includes 5 major vegetative fuel types composed of 12 major vegetation associations (including agricultural lands), 3 mostly nonvegetation associations, and 2 open-space residential developed land covers (NatureServe 2004). These different vegetative communities are listed and described in Appendix A. Each vegetative community is assigned to a specific fuel model that predicts the rate of spread, flame length, and fire intensity levels possible for each vegetation association during an average fire season under average weather conditions. Assigning a fuel model to each vegetation association within the WUI will help predict wildfire behavior and thus proper suppression response (for detailed fuel model descriptions, see Anderson 1982 and Scott and Burgan 2005).

The mean fire return interval is highly variable among vegetation associations across the WUI. Habitat-replacement wildfires or wildfires resulting in a major loss of habitat components, in conjunction with drought, will be reduced in frequency and intensity in lower desert habitats. However, moist periods may increase fire frequency and intensity in desert habitats due to increased production of annual grasses and forbs and increased annual growth of perennial grasses and shrubs (FRCC Interagency Working Group 2005a) in synergy with increased production of invasive grasses and forbs. Total wildland fuel load ranges from less than 500 lb/acre in desert and scrub/shrub types to over 20 tons/acre in dense woodland habitats.

### Vegetation Associations

The Desert Shrub-Scrub vegetation association occurs on drier upland sites and includes areas of bare ground and rock habitats that support a variety of grass, herbaceous, scrub, and shrub species (Photo 2.5). This major vegetative fuel type ranges from lower desertscrub-creosotebush-bursage associations to midelevation thornscrub types to paloverde-mixed cacti desertscrub association. The Desert Shrub-Scrub vegetation association constitutes 1,302,415 acres (66% of the WUI) and is the largest vegetation association within the Pinal County CWPP. During normal rainfall years and the typical fire season, the majority of the lowest-elevation associations (mixed salt desert and creosotebush-white bursage associations) do not support high-intensity wildfires with high rates of spread, and many wildfires self-extinguish due to a lack of contiguous ground or aerial fuels. However, during periods of extraordinary rainfall in the fall, winter, and spring months, the growth of winter annuals and forbs, in synergy with the

presence of invasive grasses and forbs (for example, buffelgrass, mustards), can produce areas with the potential for extreme rates of spread and enough intensity to ignite overstory vegetation.

The Shrublands vegetation association includes the Apacherian-Chihuahuan mesquite upland scrub and is the second largest naturally occurring vegetative type within the WUI, accounting for 115,442 acres (6% of the WUI) (Photo 2.6). The xeroriparian area within this association provides movement corridors and foraging areas for a variety of wildlife species. Adjacent vegetation associations are often a mix of semidesert grassland and desert scrub. The understory of the shrub types will vary from a mix of nonnative grass with some areas of native grasses, depending on canopy closure. Areas of higher canopy closure (>60%) support little herbaceous and perennial grass cover, which limits fine fuels needed for fire laddering and limits rate of spread. Stands of mature upland mesquite habitats can include trees with trunks and limbs greater than 6 inches diameter at breast height (dbh), providing habitat for a variety of cavity-nesting bird species. This shrubland association also provides recreational use, day use, and camping areas. Communities dominated by mature mesquites may include native or invaded graminoid understory, creating areas of open woodlands and savannas to areas of high canopy.

**Photo 2.5.** Desert Shrub-Scrub vegetation association

**Photo 2.6.** Shrublands vegetation association

The Woodland vegetative fuel type (Photo 2.7) includes the Mogollon chaparral and Madrean encinal vegetative associations. This fuel types covers 57,753 acres of the WUI (3% of all WUI acres) and is the third largest vegetative fuel type within the WUI. A major vegetative association of shrubland fuel types includes Mogollon chaparral. This ecological system occurs across central Arizona (Mogollon Rim), western New Mexico and southwestern Utah and southeast Nevada. It often dominants along the midelevation transition from the Mojave, Sonoran, and northern Chihuahuan deserts. It occurs on foothills, mountain slopes and canyons in drier habitats below the encinal woodlands. Stands are often associated with more xeric and coarse-textured substrates such as limestone, basalt or alluvium, especially in transition areas with more mesic woodlands. The moderate to dense shrub canopy includes species such as oak, sumac and ceanothus. Most chaparral species are fire adapted, resprouting vigorously after burning or producing fire-resistant seeds. Substrates are normally shallow/rocky and shaley soils at lower elevations.

**Photo 2.7.** Woodland vegetation association

Madrean encinal occurs on foothills, canyons, bajadas and plateaus in Mexico, extending north into sub-Mogollon Arizona. These woodlands are dominated by Madrean evergreen oaks along a low-slope transition normally occurring at higher elevations and within moister habitats than Mogollon chaparral. Lower elevation stands are typically open woodlands or savannas where they transition into desert grasslands, chaparral or is some case desertscrub. Common evergreen oak species include oaks, and *c*haparral species. The graminoid layer is usually prominent between trees is grassland or steppe that is dominated by warm-season grasses typical of semi-desert grasslands. This association can also be composed stands dominated by shrubby Madrean oaks typically with strong graminoid layer and in some instances invasive grasses and forbs. In transition areas with dryer chaparral systems, stands of chaparral are not dominated by the madrean encinal association, however it may extend down along drainages.

The Deciduous Southwest Riparian fuel type consists of the North American warm desert riparian mesquite bosque association. This vegetative association covers 27,139 acres and is the fourth largest vegetative association within the WUI (1% of all WUI lands). This ecological system consists of low-elevation riparian corridors along intermittent streams in valleys of southern Arizona into adjacent New Mexico, and Mexico.

Dominant trees include mesquite species while dominate shrubs include desert broom and desert willow. Vegetation, especially the mesquites, tap groundwater below the streambed when surface flows stop with high local densities of mesquites being dependent on an annual rise in the water table for growth and reproduction. This association can be intermixed with an understory of grasses and shrubs and often includes areas of near monocultures of saltcedar. This vegetation association may be underrepresented because of some xeroriparian association acres included with the shrubland associations. This vegetation association, however, contributes significantly to vegetation and wildlife biodiversity as well as to the principal recreational use areas within the WUI (Photo 2.8). In general, riparian areas have characteristics that reduce the frequency and severity of fire relative to the surrounding uplands. These characteristics include less steep slopes, surface water, saturated soils, shade, fewer lightning ignitions, cooler air temperatures, lower daily maximum temperature, higher relative humidity, higher fuel moisture content, and lower wind speed. However, late seral-stage riparian vegetation supports wildland fire similar to the surrounding potential natural vegetation group (PNVG) when a replacement fire occurs in surrounding PNVG during extreme drought and wind events. Late seral-stage riparian and bosque habitats can support nonreplacement fire in greater proportion of total fire frequency than surrounding PNVGs (FRCC Interagency Working Group 2005a: PNVG Code RIPA).

**Photo 2.8.** Deciduous Southwest Riparian vegetation association

The desert grassland fuel type is primarily represented by the Apacherian-Chihuahuan piedmont semi-desert grassland and steepe association. This is the smallest of the naturally occurring vegetative association, covering 9,907 acres (less than 1%) of all WUI acres. This ecological system consists of a broadly defined desert grassland, mixed shrub-succulent or tree savannas that are typical of the borderlands of Arizona, New Mexico and northern Mexico, but extends west to the Sonoran Desert, north into the Mogollon Rim and throughout much of the Chihuahuan Desert. It is found on gently sloping bajadas that supported frequent fire throughout the Sky Islands and on mesas and steeper piedmont and foothill slopes in the Chihuahuan Desert. Diverse perennial grasses typically characterize this association. Common grass species include grama grasses*, Eragrostis intermedia, Muhlenbergia porteri, Muhlenbergia*

*setifolia,* and succulent species of *Agave,* and *Yucca*, and tall shrub/short tree species of mesquite and various oaks. Many of the historical desert grassland and savanna areas have been converted, some to mesquite upland scrub types from woody species invasions through intensive grazing and other land uses.

Historic grassland communities are found in Pinal County west of the San Pedro River basin extending from the foothills of the Catalina Mountains on the east, north and west. Gori and Enquist (2003:4) classified these grasslands as a "shrub-invaded native grassland with restoration potential . . . composed of native perennial grasses and herbs (non-native grasses absent or uncommon) with 10-35% total shrub cover and mesquite or juniper cover <15% . . . shrub cover can be reduced using prescribed burns and the site restored back to a TYPE A [native grassland with low shrub cover] either immediately or after some period grazing rest (<15 years) when sufficient fine fuels have accumulated for fire spread".

Included within the total WUI are residential and open-space community lands occurring in the developed areas of the community. As depicted in the SWReGAP land cover shows that within the WUI approximately 95,569 acres (5%) of lands evaluated for wildland fire potential within the WUI are "developed," with at least 20 percent of the land cover consisting of nonpervious surfaces (Photo 2.9). However, private lands within the WUI account for approximately 41 percent of all WUI lands. Therefore, much of the WUI lands analyzed include private lands that are predominantly naturally landscaped. Developed, Open Space–Low Intensity lands include areas with some construction materials but mostly consist of native vegetation associations. Impervious surfaces account for less than 20 percent of total cover and most commonly include large-lot single-family housing units or multiple-acre private lands in single ownership, parks, golf courses, and vegetation planted in developed settings for recreation, erosion control, or aesthetic purposes. Developed, Open Space, Medium-High Intensity lands includes areas with a mixture of constructed materials and vegetation. Impervious surfaces account for 20 to 49 percent of total cover. These areas most commonly include single-family housing units. Developed, Medium–High Intensity lands include areas with a mixture of constructed materials and vegetation. Impervious surface accounts for 50 to 79 percent of the total cover. These areas most commonly include single-family housing units, including highly developed areas where people reside or work in high numbers; examples include apartment complexes, row houses, and commercial/industrial. These lands may be considered at low risk for wildland fire. However, the threat of fire (structural or wildland ignition) spreading from developed lands to wildlands has been considered in determining risk within the WUI.

**Photo 2.9.** Developed lands within the WUI

Several fuel hazard components, including vegetation type and density, previously burned areas, and slope and aspect, were analyzed for wildland fire potential. For example, areas of the WUI can be heavily dissected, with some areas having slopes exceeding 20 percent that are heavily vegetated with trees and shrubs. Slopes greater than or equal to 20 percent and areas with south-, southwest-, or west-facing slopes in areas of high wildland fuels were identified as having greater risks because of fuel-ladder fire effects and convectional preheating of vegetative fuels associated with steep terrain and decreased humidity associated with the microclimates created by exposed aspects. Areas with moderate fuel hazards on slopes greater than or equal to 20 percent are considered a high fuel hazard, while the same fuel type on slopes less than 20 percent is still considered a moderate fuel hazard. During extraordinary rainfall years, when rainfall is above average during the fall, winter, and spring months, increased germination and growth of Mediterranean grass (*Schismus barbatus*), buffelgrass (*Pennisetum ciliare*), and other invasive species (see Appendix E and AZ-WIPWG 2005) and winter annuals grasses and forbs, can result in more continuous fine fuel cover. This change in fine fuel continuity can result faster rates of spread and increased intensity levels that do not normally sustain wildland fire. These areas of low-risk vegetation associations, including lower elevation desert shrub-scrub associations in combination with “deep, coarse to fine textured, nearly level to gently sloping soils on floodplains and lower alluvial fans” (Hendricks 1985) will be favored by some invasive grasses (Hauser 2008 and Rogstad 2008) will, under these extraordinary circumstances, become areas of extremely high wildfire risk (Photo 2.10).

**Photo 2.10.** Wildland fire in desert scrub during above-normal rainfall year

Figure 2.4 shows areas of vegetative fuel hazard during a typical fire season. During a normal fire season, low-risk vegetative associations will be enhanced to a moderate level by influencing effects of slope and aspect, in a similar manner as moderate-risk vegetative associations will increase to high risk from these same influencing factors. Other untreated or unburned areas that fall under the category of moderate ground fuels and that do not overlap areas with steep slopes or with south, southwest, or west aspects are considered a moderate risk from fuel hazards. All other areas have a low risk from fuel hazards, including the areas that have been treated or burned within the last two decades. The wildland fuel hazards component influence was compiled to depict areas of high, moderate, and low wildland fire potential based on vegetation type, density, and arrangement and to show areas with higher wildfire risk and therefore of greater concern to the Core Teams during years of extraordinary rainfall and enhanced fire conditions creating extreme fire behavior. Table 2.4 identifies these various fuel hazards components and their assigned values. Visual representations of these fuel hazard components during extreme fire seasons are mapped in Figure 2.5.

**Table 2.4.** Fuel hazard components

| Component | Influence[a] |
|---|---|
| *Vegetation type and density* | |
| Woodlands in Fuel Models 4,6, and 9; Deciduous Riparian >100 stems/acre; or moderate fuel types in slopes ≥20% | H |
| Upland Shrubland associations in Fuel Models 1 and 3 and desert shrublands and grasslands 2, 3, and 6 | M |
| Desert Scrub associations, barren land types, agriculture and developed areas | L |
| *Burned areas* | L |
| *Slopes ≥20%* | H |
| *Aspect (south-, southwest-, or west-facing slopes)* | M |

*Source*: Logan Simpson Design Inc.
[a] H = high, M = moderate, L = low

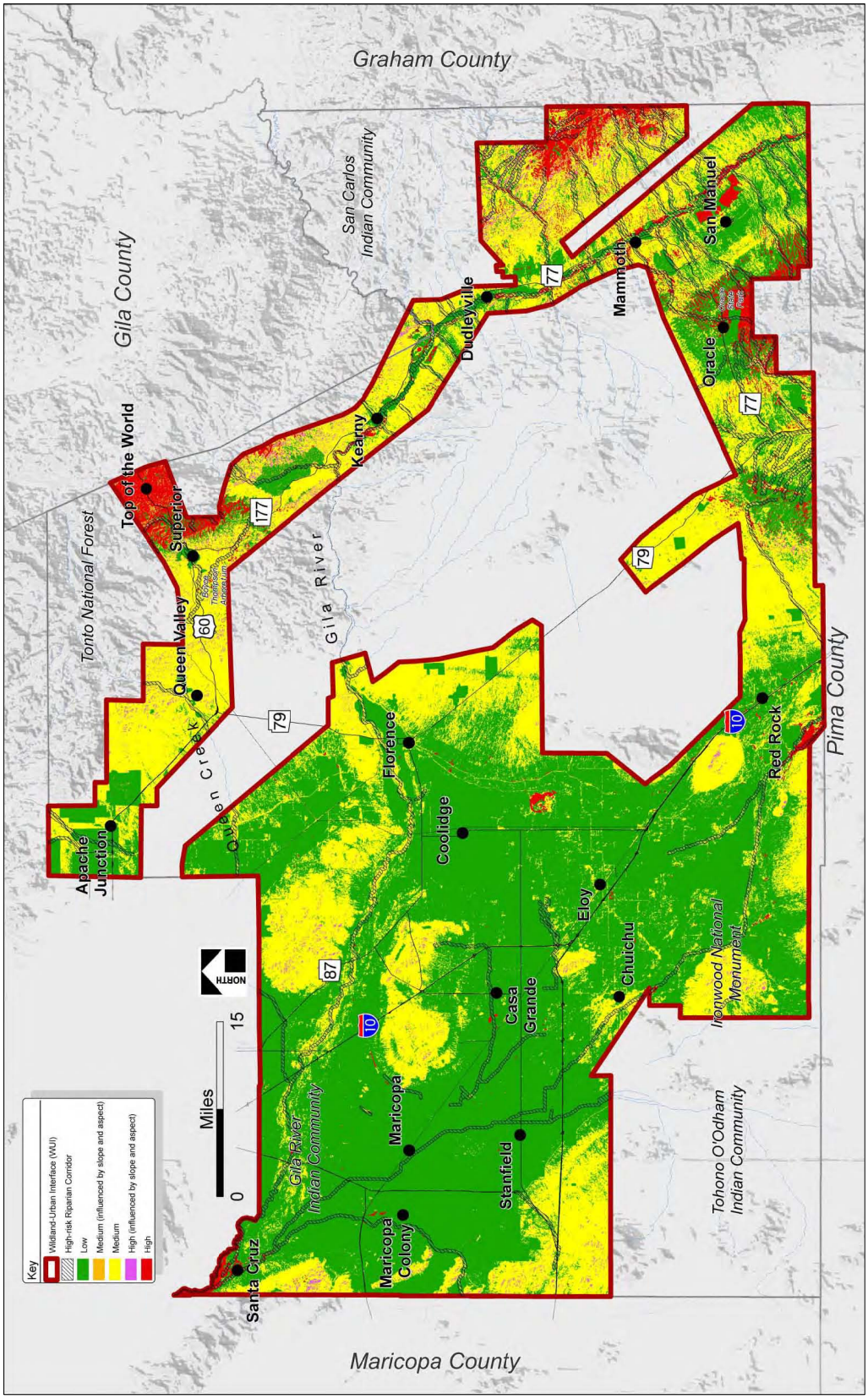



**Figure 2.4.** Pinal County CWPP wildland fuel hazards during typical fire season

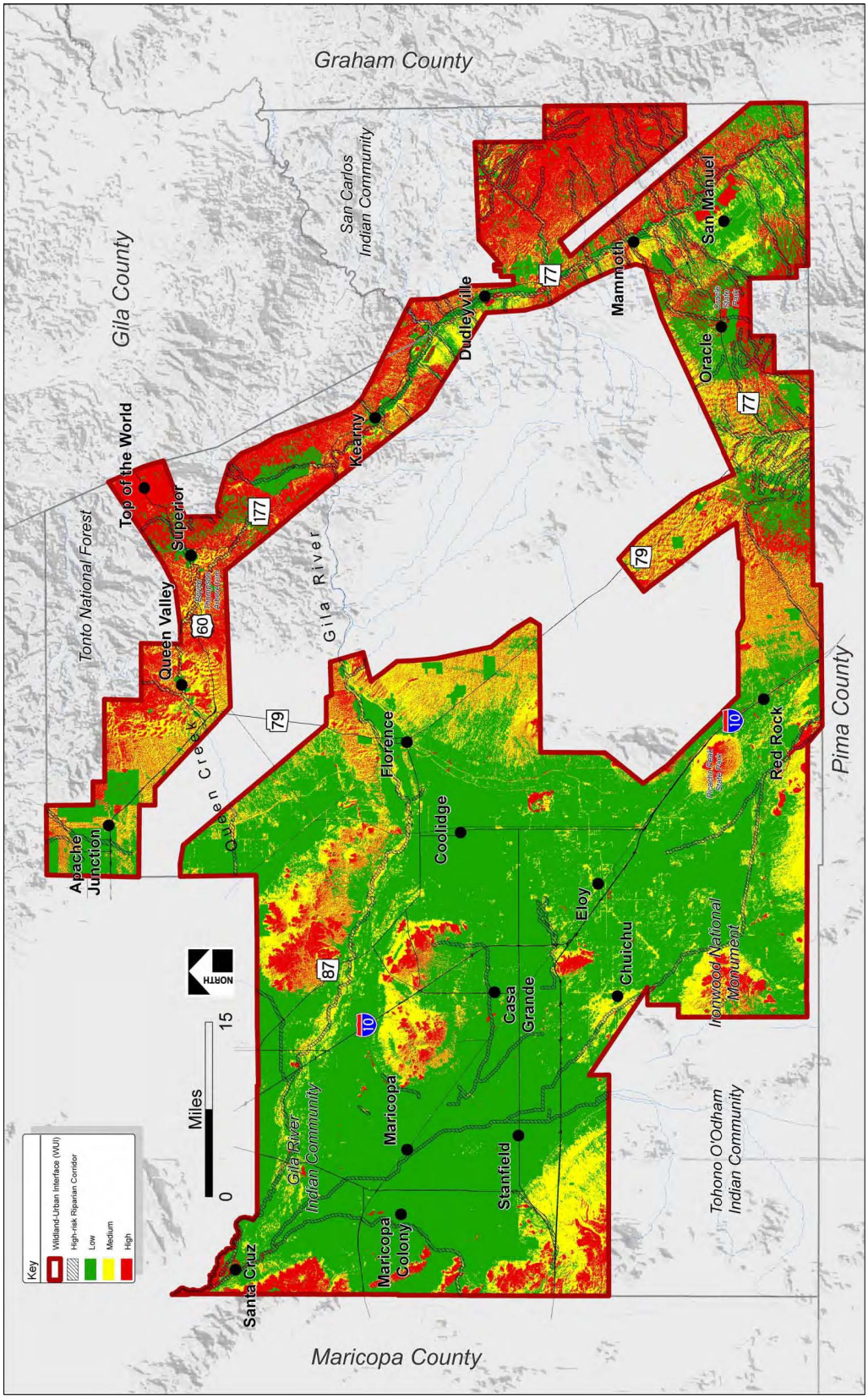



**Figure 2.5.** Pinal County CWPP wildland fuel hazards during extraordinary rainfall years

Riparian corridors, shrublands, and vegetation associations occurring in steep slopes with a south or southwest aspect are the greatest wildland fuel hazards within the Pinal County CWPP. Saltcedar-invaded and early-seral-stage riparian habitats constitute a second major wildland fire risk vegetative association. Shrubland areas constitute the next greatest wildland fire risk, in relation to high slopes and south or southwest aspects. In riparian vegetation associations where riparian deciduous tree species are located, total wildland fuels can exceed 20 tons per acre and produce flame lengths greater than 6 feet above the overstory with a rate of spread of over 525 feet (8 chains) per hour. In addition, some shrublands with heavy invasions of nonnative grasses can produce wildfires of high intensity and high rates of spread that are capable of igniting adjacent overstory vegetation. Moderate wildland fuel risk is associated with the ecotone of the riparian and desert upland vegetation associations. In areas where shrub canopy exceeds 35 percent, light fuels produced by the herbaceous understory are reduced because of overstory shading and competition from overstory shrub species. Under extreme fire conditions, upland shrub communities can carry crown fires with moderate intensities and high rates of spread. Lower wildland fire risk occurs in desert scrub communities in which total fuel loading is low with no continuous arrangement of ground or aerial fuels. Desert upland vegetation associations are not fire-dependent communities and wildfires within desert vegetation associations will be suppressed during years of above-normal rainfall when wildfires occurring in these vegetative associations may not self-extinguish.

### C. Conditions of Ignition and Past Fire Occurrence

Past regional wildfire events are important for determining the potential of an area to support wildland fire. Because of the combination of current drought conditions and a regional history of fires, there will be wildland fire ignitions within the WUI that must be suppressed. The fire history of the planning area, including recent large wildfires that have occurred within or close to the WUI, has been included in this analysis to determine the most likely areas for either natural or human wildland fire ignition. Table 2.5 details the high, moderate, and low positive-influence values assigned to fire-start incidents. These include concentrated areas of lightning strikes and human-caused ignitions. High-potential areas have the greatest number of fire starts per 1,000 acres. Wildland fire ignition data is obtained from the Federal Wildland Fire Occurrence Internet Mapping Service (IMS) Web site and database (http://wildfire.cr.usgs.gov/firehistory/). The Federal Fire Occurrence IMS is an interactive GIS for use in the wildland fire and GIS community. The datasets used in this GIS are based on official fire occurrence data collected from five federal agencies that have been merged into one fire history point layer. According to the IMS database 3,945 wildfire ignitions have been reported within the WUI since 1980. The areas with the greatest potential for fire ignition, either from natural or human (though unplanned) causes, are found within the TNF along the northeastern portion of the WUI, including Superior, Top of the World, and Kearny-Winkelman areas, and also within the northwestern portion of the WUI, including the Gila River Indian Community. Moderate fire occurrences are found in the xeroriparian corridors in proximity to the community of Santa Cruz and the Greene Wash area within the WUI and the San Pedro River riparian corridor (Figure 2.6).

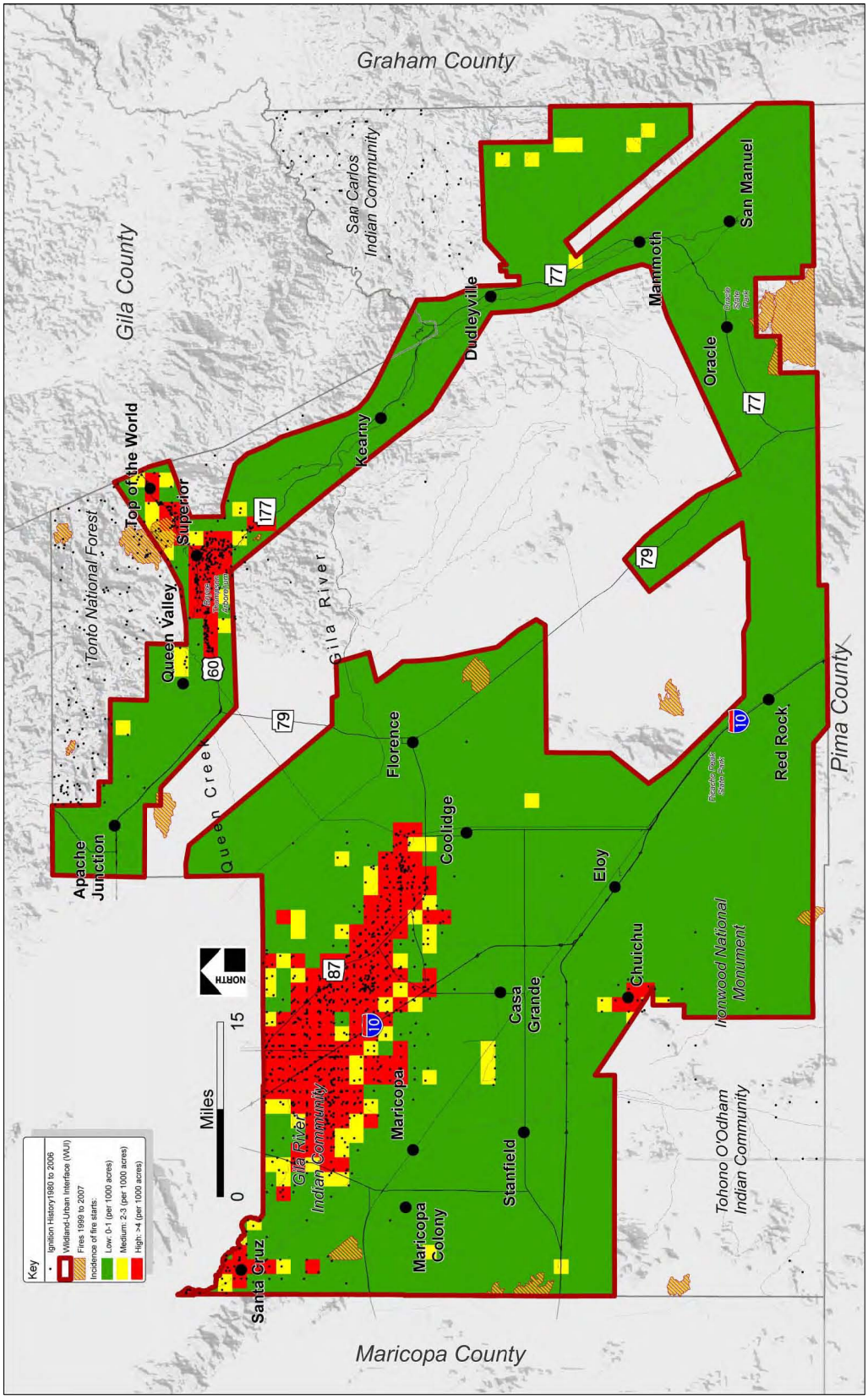



**Figure 2.6.** WUI ignition history

**Table 2.5.** Ignition history and wildfire occurrence

| Wildfire occurrence | Value |
|---|---|
| 0–2 fire starts/1,000 acres | L |
| 2–4 fire starts/1,000 acres | M |
| >4 fire starts/1,000 acres | H |

### D. Community Values at Risk

Valued at-risk community resources include private and community structures, communication facilities, power lines, local recreation areas, cultural and historic areas, sensitive wildlife habitat, watersheds, natural resources, and air quality. As agreed to by the Core Teams, developed land and other infrastructures within the area of highest flammability were given the highest priority for protection. In areas where community values occur within or adjacent to areas of high risk due to the fuel hazards of vegetation associations, a cumulative risk from catastrophic wildland fire was created.

These areas of cumulative risk are of greatest concern to the community. In accordance with Risk Factor 2: Risk to Social, Cultural and Community Resources identified by the Arizona State Forester (2007b:2), the Core Teams have determined that the Pinal County WUI does include areas consistent with Risk Factor 2, Situations 1, 2, and 3 (Photos 2.11 and 2.12), as follows:

> Risk Factor 2: Risk to Social, Cultural and Community Resources
>
> Situation 1: This situation most closely represents a community in an urban interface setting. The setting contains a high density of homes, businesses, and other facilities that continue across the interface. There is a lack of defensible space where personnel can safely work to provide protection. The community watershed for municipal water is at high risk of being burned to other watersheds within the geographic region. There is a high potential for economic loss to the community and likely loss of housing units and/or businesses. There are unique cultural, historical or natural heritage values at risk.
>
> Situation 2: This situation represents an intermix or occluded setting, with scattered areas of high-density homes, summer homes, youth camps, or campgrounds that are less than a mile apart. Efforts to create defensible space or otherwise improve the fire-resistance of a landscape are intermittent. This situation would cover the presence of lands at risk that are described under state designations such as impaired watersheds or scenic byways. There is a risk of erosion or flooding in the community of vegetation burns.
>
> Situation 3: This situation represents a generally occluded setting characterized by dispersed single homes and other structures that are more than a mile apart. This situation may also include areas where efforts to create a more fire-resistant landscape have been implemented on a large scale throughout a community or surrounding watershed.

**Photo 2.11.** Example of an area of elevated concern

**Photo 2.12.** Unpaved road to a rural homestead

### 1. Housing, Businesses, Essential Infrastructure, and Evacuation Routes

The Core Teams identified high-risk areas, including portions of Interstate Highway 10 (I-10) and Interstate Highway 8 (I-8), US 60, SR 77, SR 177, SR 79, SR 347, SR 238 and SR 87, which continue to be the focus of commercial development. Residential community development is occurring throughout the WUI in a mix of high-density, single-family, and multiacre parcels. Structures associated with housing and commercial development located in isolated subdivisions and in more dispersed areas of the WUI are also at high risk.

The Core Teams identified transportation corridors that will serve as evacuation routes and resource distribution corridors during a wildland fire. The Core Teams have also recommended fuel modification treatments for evacuation corridors that will provide safe evacuation as well as emergency vehicle response during a catastrophic wildland fire in the WUI.

### 2. Recreation Areas/Wildlife Habitat

Recreational features—including recreational and camping areas associated with the San Tan Mountain Regional Park; Lost Dutchman, Oracle, and Picacho Peak State Parks; Boyce Thompson SW Arboretum; and designated camping and recreation areas within CNF-, TNF-, and BLM-managed public lands within and adjacent to the WUI—are located throughout Pinal County. These parks and recreational areas provide scenic vistas of deep canyons, dry washes, sheer cliffs, distant mountain ranges, colorful soils and rock formations, and mosaics of different vegetation.

These features are environmental, economic, and aesthetic resources for the surrounding communities and provide year-round recreational opportunities. Because of the benefits that these recreation areas provide to local citizens and community visitors and the potential for increased human-caused wildfire ignitions with increased recreational use, these areas have been analyzed as community values and have an influencing factor on wildland fire risk.

The WUI also includes known and potential habitat areas for several threatened, endangered, and sensitive (TES) species. Uplands within the WUI provide Sonoran desert tortoise habitat, while riparian corridors include southwestern willow flycatcher habitat. The land-management agencies use conservation strategies to mitigate risk to these species by implementing programs that meet natural-resource-management goals and objectives. Wildland fuel and vegetative restoration treatments within sensitive-species habitat may require additional site-specific analysis because of the extraordinary circumstances created by the presence of sensitive species or their habitats. Before any vegetation treatment by the BLM, TNF, or CNF, a biological assessment and evaluation will be conducted by the appropriate district office wildlife biologist to determine the extent of impacts the treatments will have on TES species and habitats. The Core Teams reviewed Section 102.a.5.B of HFRA and understand that site-specific evaluations of individual recommended projects will determine whether sensitive wildlife species and habitats would benefit from habitat-enhancing treatments for reducing wildland fuel effect by lessening the threat of catastrophic wildland fire in the vegetative communities of the WUI, while also protecting the recreational values that local residents and visitors associate with the community.

### 3. Local Preparedness and Protection Capability

For many years, the Insurance Services Office (ISO) has conducted assessments and rated communities on the basis of available fire protection. The rating process grades each community's fire protection on a scale from 1 to 10 (1 is ideal and 10 is poor) based on the ISO's Fire Suppression Rating Schedule. Five factors make up the ISO fire rating: water supply—the most important factor—accounts for 40 percent of the total rating, while type and availability of equipment, personnel, ongoing training, and the community's alarm and paging system account for the remaining 60 percent of the rating. Some areas within the Pinal County WUI are not within a fire district; the ISO rating for these areas is 10. Other communities and

municipalities within the WUI are within a fire department or district and have ISO ratings ranging from 3 to 9; these areas are included in the overall risk analysis as reducing the potential of catastrophic wildland fire. ISO ratings will vary within fire departments and districts depending on housing densities and distance of structures isolated (usually 3 to 5 miles) from a fire station.

The wildland and structural fire response within the WUI is provided by local fire departments and districts. BLM, TNF, CNF, and local fire departments and districts provide support for initial wildland fire attack for areas within and adjacent to the Pinal County CWPP WUI. Initial attack response from additional local fire departments and districts can occur under the authority of mutual-aid agreements between individual departments or under the intergovernmental agreements (IGAs) that individual fire departments and districts have with the Arizona State Forester and adjacent fire departments and districts.

Land use in the planning area consists primarily of residences; agriculture; livestock production; community businesses; and community services, such as hospitals, schools, organized-sports facilities, and airports. Surrounding areas are dominated by state lands; BLM, TNF, and CNF lands; and private properties. Land uses within or close to the WUI include fuelwood cutting, hunting, and other recreational activities (for example, hiking, bird watching, nature study, photography, and off-road-vehicle use). Section II.E of this CWPP provides a more detailed community assessment.

State Trust lands occur on the periphery of the communities and often surround developed private land parcels. State trust lands are administered by ASLD, are managed for a variety of uses, and account for 30 percent (597,470 acres) of the WUI. State trust lands within and adjacent to the WUI could be identified for sale for residential and commercial development or leased for commercial land development.

The primary block of federal land in the Pinal County CWPP area consists of portions of BLM lands located throughout the WUI, TNF lands located in the northern portion of the WUI, and CNF lands located in the southern portion of the WUI. Pinal County provides extensive outdoor recreational opportunities. The open space provided by federal lands and recreational opportunities, in association with the significant wildlife habitats found within the county, provide the quality-of-life amenities that many county residents desire to protect and enhance.

Table 2.6 identifies the different values given to these community value components. Visual representations of these community value components are mapped in Figure 2.7.

**Table 2.6.** Community values

| Component | Value[a] |
|---|---|
| Housing and business structures and infrastructure in the WUI ≥1,000 households/mi$^2$ | H |
| Recreation areas and infrastructure in the WUI ≥500 and <1,000 households/mi$^2$ | M |
| All other areas | L |

*Source:* Logan Simpson Design Inc.

[a]H= high; M = moderate; L = low

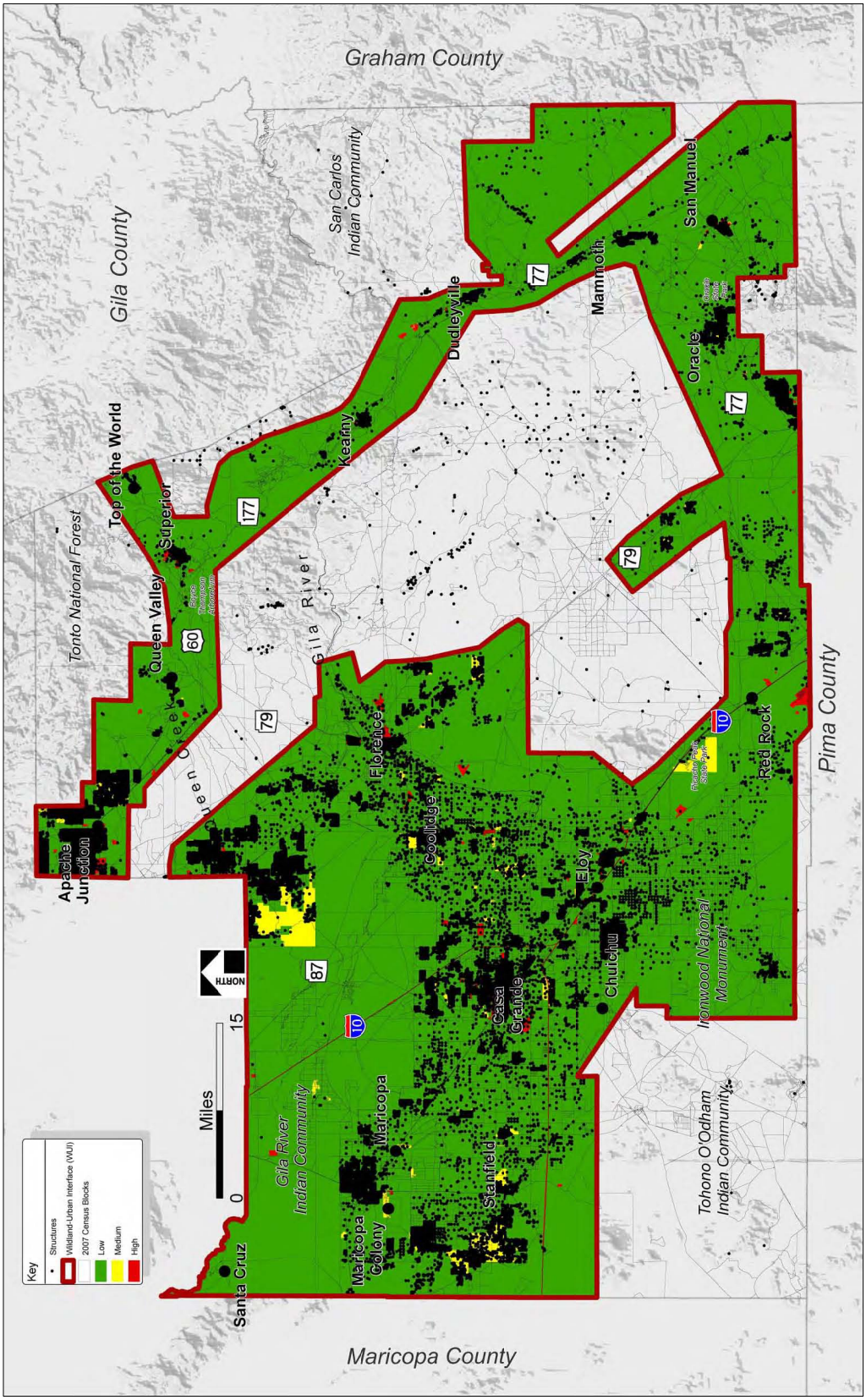



**Figure 2.7.** Pinal County CWPP community values

## E. Summary of Community Assessment and Cumulative Risk Analysis

The major concerns of the Core Teams and collaborators are (1) delayed response time by available mutual-aid fire departments; (2) obtainment of additional firefighting equipment and training; and (3) insufficient dispatch and communication capabilities on initial response units. Additionally, many residences in the identified WUIs were not designed with adequate general or emergency vehicle access. Private structures without adequate access and readily available water supplies increase the risk of greater habitat and structural losses from large wildland fires. Some fire departments and districts have developed an incident action plan for sections of the WUI, such as is disclosed in the *Oracle Community Wildfire Protection Plan* (Oracle Fire District 2008), but further assessments need to be completed. Recommendations to landowners for wildfire risk mitigation are included in Section III of this CWPP. Additional recommendations for remote private lands include identifying properties by placing names or addresses on identification placards, road signs, and wells or surface water sources that could be used to replenish water supplies for fire response equipment—both ground-based drafting and aerial bucketing. Water-source names can be placed on placards or road signs as a direction resource to responding firefighters. The Core Teams recommend researching the possibility of an emergency contact autophone redial system for emergency alert notifications within the WUI.

The communities within each WUI are described below in more detail. The community descriptions include data on population and housing units, major transportation routes, major vegetation associations, and a summary of where in the WUI the highest risk of wildland fire occurs. Information (name, location, size) on fires within the last 3 years is included when available. Population and housing data was obtained from the US Census Bureau 2000 data unless noted otherwise. Population data from 2007 was obtained from the Arizona Department of Commerce Community Profiles, US Census Bureau updated data, and compiled data from the Arizona Department of Economic Security Research Division. The 2007 estimates for unincorporated areas are based on growth rates projected by the Regional Council of Governments. Housing unit information was not available beyond 2000 for some individual communities.

### 1. Eastern Sub-WUI Communities

Kearny Sub-WUI

The Kearny sub-WUI includes the incorporated community of Kearny and areas along the Gila River riparian corridor south of the confluence of the Gila and San Pedro Rivers and north of the municipality along SR 177 to south of the town of Superior. The community of Kearny, listed as moderate risk in the *Arizona-Identified Communities at Risk* (Arizona State Forester 2007a), is located within the Kearny sub-WUI. Kearny is a rural community located along SR 177 and adjacent to the Gila River riparian corridor. SR 177 is the only major transportation route for this community; it connects to SR 77 to the southeast and US 60 to the northwest. According to 2000 census data, the population of the town of Kearny is 2,249 (2007 estimates: 2,282). There are 871 housing units, of which 585 are classified as owner-occupied units are classified as detached single-family units. Land ownership within the WUI is primarily BLM land with private landownership scattered along SR 77 and SR 177 within the main developed areas of the community. ASLD owns land parcels along the Gila River riparian corridor and areas along SR 77 and SR 177. The areas at highest risk for wildland fires within the WUI occur along both sides of the Gila River

riparian corridor in areas on ascending slope in conjunction with woodland vegetation associations. The Gila River riparian corridor, with associated side channels and drainages within the Kearny sub-WUI, are considered areas of elevated risk from wildland fire. Vegetation associations at highest risk for wildfire consist primarily of riparian, woodland, and mixed desert scrub. Analysis of fire-start data for the last 27 years (since 1980) indicates that the highest incidences of ignition are within the riparian corridor. Because of the high-risk rating for the majority (56%) of the Kearny sub-WUI, an elevated risk within the riparian corridor, and limited access and wildland fire response, the overall wildland fire risk rating of the sub-WUI is high.

### Mammoth Sub-WUI

The Mammoth sub-WUI includes the community of Mammoth and areas outside the Mammoth Fire District boundary along the San Pedro River riparian corridor, north of the Veterans Memorial Blvd intersection with SR 77, and north along SR 77 to just south of the confluence of the San Pedro River and Aravaipa Creek. Mammoth is a rural community located along SR 77 and adjacent to the San Pedro River riparian corridor. SR 77 is the only major transportation route for this community. According to 2000 census data, the population of the community of Mammoth is 1,762 (2007 estimates: 1,783). There are 679 housing units, of which 293 are classified as owner-occupied units and 389 are classified as detached single-family units. The areas at highest risk for wildland fires within the WUI occur primarily along the San Pedro River riparian corridor and in upland areas with ascending slope to the east of the riparian corridor. The San Pedro River riparian corridor, with associated side channels and drainages within the community of Mammoth, are considered areas of elevated risk from wildland fire. Vegetation associations at highest risk for wildfire consist primarily of riparian, woodland, and mixed desert scrub. Analysis of fire-start data for the last 27 years (since 1980) indicates that the highest incidences of ignition are within the San Pedro River riparian corridor. Because of the low-risk rating for the majority (72%) of the Mammoth sub-WUI, an elevated risk within the riparian corridor, and limited access and wildland fire response, the overall wildland fire risk rating of the sub-WUI is low.

### San Manuel Sub-WUI

The San Manuel sub-WUI includes the unincorporated community of San Manuel and areas outside the San Manuel Fire District north to SR 77, east of the San Pedro River corridor, south to the Pinal County boundary, and west to the Oracle sub-WUI. San Manuel is a rural community located adjacent to the San Pedro River riparian corridor on Veterans Memorial Blvd south of the community of Mammoth. Veterans Memorial Blvd is the only major transportation route for this community; it connects to SR 77 northwest of San Manuel. According to 2000 census data, the population of the town of San Manuel is 4,375. There are 1,832 housing units, of which 938 are classified as owner-occupied units and 1,352 are classified as detached single-family units. The areas at highest risk for wildland fires within the WUI occur primarily along the San Pedro River riparian corridor and in upland areas with ascending slope to the east of the riparian corridor. Additionally, areas of high risk are located within the southwestern portion of the sub-WUI, within woodland vegetation associations occurring adjacent to the CNF, and within the area extending northeast of the CNF to SR 77. Fires in this area of the sub-WUI could create concerns for wildfire response resources and community evacuation along Veterans Memorial Blvd north to SR 77. In extreme

wildfire conditions community evacuations may be directed south along Veterans Memorial Blvd toward the community of Cascabel and eventually to I-10 at Benson. The San Pedro River riparian corridor, with associated side channels and drainages within the San Manuel sub-WUI, are considered areas of elevated risk from wildland fire. Vegetation associations at highest risk for wildfire consist primarily of riparian, woodland, and mixed desert scrub. Analysis of fire-start data for the last 27 years (since 1980) indicates that the highest incidences of ignition are within the riparian corridor. Because of the low-risk rating for the majority (72%) of the San Manuel sub-WUI, an elevated risk within the riparian corridor, and limited access and wildland fire response, the overall wildland fire risk rating of the sub-WUI is low.

### Dudleyville Sub-WUI

Dudleyville is located primarily within the riparian corridor of the San Pedro River adjacent to SR 77 between the communities of Mammoth and Kearny. The community of Dudleyville, listed as low risk in the Arizona-*Identified Communities at Risk* (Arizona State Forester 2007a), is located within the Dudleyville sub-WUI. As reported in the 2000 US Census, the population of Dudleyville is 1,323, with 572 housing units; it has a land area of 6.88 square miles, and a population density of 192.31 people per square mile. The Dudleyville Fire District provides structural and wildland fire protection services to the community. The areas at highest risk for wildland fires within the Dudleyville sub-WUI are primarily along the San Pedro and Gila River riparian corridors and associated side channels and upland areas with ascending slope to the east and west of the river corridors. Additionally, areas of extreme risk are located within the riparian corridor where saltcedar-invaded riparian vegetation with heavy ground fuels is found within or adjacent to structures. Developed lands occur on both sides of the riparian corridor, with few roads crossing the river channel. Firefighting response and community evacuation, if necessary, could be delayed due to limited access. Analysis of fire-start data for the last 27 years (since 1980) indicates that the highest incidences of ignition are within the riparian corridor. Wildfire ignitions have been recorded on both sides of the riparian corridor. Because of the low-risk rating for the majority (68%) of the Dudleyville sub-WUI rated, an elevated risk from the density of developed areas within the riparian corridor, and limited access and wildland fire response, the overall wildland fire risk rating of the sub-WUI is moderate.

### Galiuro Mountains Sub-WUI

The Galiuro Mountains sub-WUI is located east of the San Pedro River corridor and includes private, mostly undeveloped lands, located on the west-facing foothills of the Galiuro Mountains. These private lands are not within a fire department or district, and no obligated structural fire protection is available to residents. Wildland fire responses would be provided by ASFD, BLM, or FS wildfire response resources. Analysis of fire-start data for the last 27 years (since 1980) indicates that the highest incidences of ignition are within the upper elevations of the Galiuro Mountains in the easternmost portion of the WUI. Vegetation associations occurring in higher elevations create a high fire risk during normal fire seasons. In extreme rainfall years, production of light fuels from invasive grasses, will produce areas of high risk on the lower foothills where woodland vegetation associations are associated with steep slopes and southerly exposures. Numerous xeroriparian areas traverse the sub-WUI from east to west, from the higher elevations of the Galiuro Mountains to the San Pedro River; this creates additional areas of potential elevated wildfire concern. Although areas of high risk with a moderate history of wildfire ignitions

predominate large areas of this sub-WUI, the lack of structure and infrastructure do not create high priorities for wildfire mitigation within the Pinal County CWPP WUI. Even though the majority (67%) of the Galiuro Mountains sub-WUI has a high-risk rating because of vegetative fuels, structure and population density is low, and the sub-WUI is not within a fire district; therefore, the overall wildland fire risk rating of the sub-WUI is low.

Oracle Sub-WUI

The Oracle sub-WUI includes the unincorporated community of Oracle and areas outside the Oracle Fire District south to the CNF, east along SR 77 to the Mammoth/San Manuel sub-WUI boundary, and west to the Golder Ranch sub-WUI. Oracle is a rural community located along SR 77 at an elevation of approximately 4,500 feet. The community of Oracle, listed as high risk in the Arizona-*Identified Communities at Risk* (Arizona State Forester 2007a), is located within the Oracle sub-WUI. SR 77 is the only major transportation route for this community. According to 2000 census data, the population of the town of Oracle is 3,563. There are 1,571 housing units, of which 684 are classified as owner-occupied units and 1,018 are classified as detached single-family units. The Oracle sub-WUI also includes Oracle State Park, a 4,000-acre environmental education facility and park in the foothills of the Catalina Mountains. Oracle State Park offers day-use picnic sites and over 15 miles of nonmotorized trails. Public use of the state park in proximity to the community does increase risk of wildfire ignitions, as well as potentially involving the notification and evacuation of park visitors. In 2008, in response to community concerns of the threat of wildfire to the community and in conjunction with funding needs to mitigate risk, Oracle residents and the Oracle Fire District established the Oracle Firewise Communities Board and developed the *Oracle Community Wildfire Protection Plan*. The Core Teams commend the action taken by the community and have included for reference the recommendations described in the *Oracle Community Wildfire Protection Plan*. The Oracle Fire District covers 31 square miles and includes 106 fire hydrants that produce 400 to 1,250 gallons of water per minute. The Oracle Fire District provides structural and wildland fire response to over 1,500 structures. The fire district is staffed year-round on a daily basis by full-time, part-time, and volunteer firefighters and maintains mutual-aid agreements with neighboring fire departments and districts. The Oracle Fire District has an ISO rating of 7. The community has been active in public outreach, including participation in major community events, a newly established Firewise Web site, spring and fall newsletters mailed to all households, wildfire prevention workshops, on-site property evaluations, operation of a community brush-disposal site, cooperation in vegetative fuel reduction projects with the Arizona Department of Corrections Wildland Crews and CNF personnel. Wildfire history within the community includes the Cherry Valley, Two O'clock, Hill, Oracle State Park, and Rockcliff fires, ranging from 20 to 200 acres in size. The *Oracle Community Wildfire Protection Plan* includes a listing of priority fuel reduction projects such as fuelbreaks along the community boundaries with the CNF, Oracle State Park, and state trust lands and vegetative fuel reductions along SR 77, community roadways, and private-public land boundaries. The community of Oracle has written, mapped, and coordinated community evacuation with the Pinal County Sherriff's Office, PCOEM, and other public safety and disaster-relief agencies. An emergency autodialer system is located in the fire station and has been programmed with all local telephone numbers. The system will be operated by volunteers from the Oracle Community Emergency

Response Teams in case of community evacuation. The *Oracle Community Wildfire Protection Plan* is available for inspection at the Oracle Fire District if additional or specific information is desired.

The areas at highest risk for wildland fires within the Oracle sub-WUI occur primarily along the upland slopes of the Catalina Mountains in the southern portion of the WUI. Vegetation associations within the community include woodland and chaparral types that have a high potential to support and transport wildland fire. The southern and eastern portions of the sub-WUI with ascending slopes are at greatest wildfire risk. Additionally, these areas of high risk, including the xeroriparian areas of Cottonwood Wash and Big Wash, which bisect SR 77; wildfires within this area of the sub-WUI could create concerns for wildfire response resources and community evacuation along SR 77. Analysis of fire-start data for the last 27 years (since 1980) indicates that the highest incidences of ignition occur within or adjacent to the sub-WUI either within or adjacent to the CNF. The majority (62%) of the Oracle sub-WUI has a low-risk rating; however, with an elevated risk from structure density, a history of wildfire ignitions, and proximity to high vegetative fuels, the overall wildland fire risk rating of the sub-WUI is high.

Apache Junction Sub-WUI

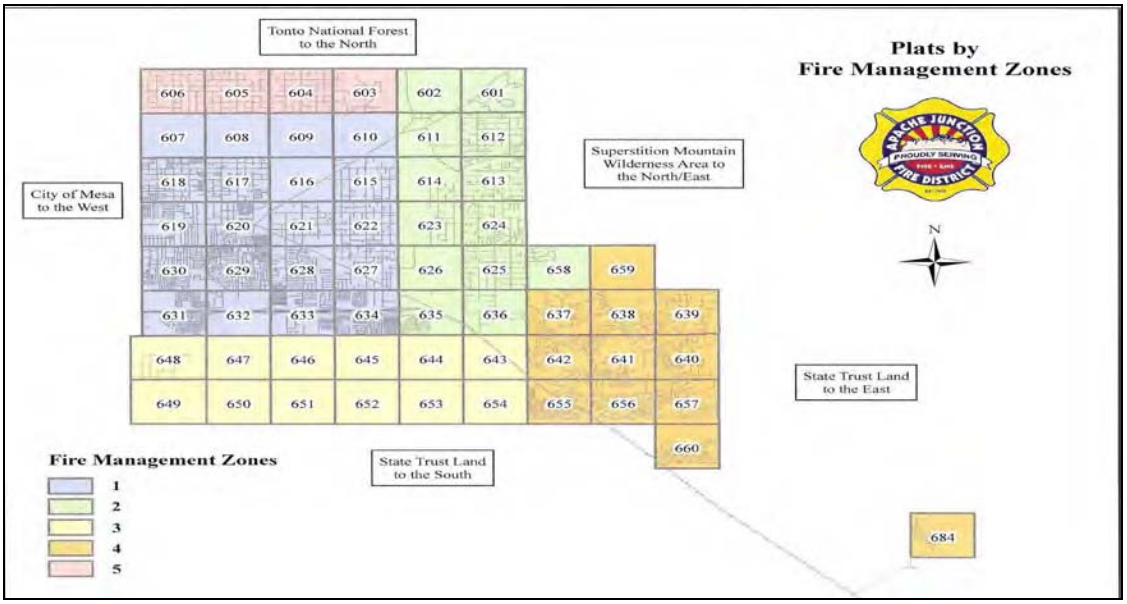
Apache Junction is a rural community located within Pinal County along US 60 approximately 30 miles east of Phoenix. US 60 is the major transportation route for this community; SR 79 also serves as a transportation route for Apache Junction. The Apache Junction Fire District encompasses 62 square miles and serves the city of Apache Junction and unincorporated areas of Gold Canyon, Superstition Foothills, and the Goldfield Foothills area. The Apache Junction sub-WUI consists primarily of bedroom communities supporting some industry. According to 2000 census data, the population of the city of Apache Junction is 31,814 (2007 estimates: 37,529), with the estimated population supported by the fire district at 86,000. There are 38,262 housing units within the fire district, of which 20,197 are classified as single-family units and 18,065 are classified as retirement units. The Apache Junction Fire District has an ISO rating of 3. The fire district is bordered by the TNF as well as state lands. These border areas are defined as WUI areas and are the focus of the Pinal County CWPP for this sub-WUI.

The Apache Junction Fire District is divided into separate and distinct fire management zones (FMZs) for response and deployment analysis and planning

- FMZ 1 encompasses the majority of the populated area within the city of Apache Junction. Fire Stations 261 and 263 provide primary response coverage for the city's inhabited 20 square miles. The population of FMZ 1 is estimated at 55,245 (Apache Junction Fire District GIS and US Bureau of Census data).
- FMZ 2 comprises the Superstition Mountain Foothills area. Fire Station 262 provides primary response coverage for the area's 13 square miles. The population of FMZ 2 is estimated at 5,973 (Apache Junction Fire District GIS and US Bureau of Census data).
- FMZ 3 covers 12 square miles of mostly vacant state trust land south of US 60. This FMZ receives service primarily from Fire Stations 263 and 262. The population of FMZ 3 is estimated at 0 (Apache Junction Fire District GIS and US Bureau of Census data).
- FMZ 4 encompasses 13 square miles and includes the communities of Gold Canyon, Mountain Brook, Kings Ranch, Superstition Mountain and Peralta Trails and the surrounding areas. Fire

Station 264 provides primary response coverage for the area. The population of FMZ 4 is estimated at 22,117 ( Apache Junction Fire District GIS and the US Bureau of Census data).

- FMZ 5 encompasses the Goldfield Foothills area. This area, encompassing 4 square miles, receives service primarily from Fire Stations 261 and 263. The population of FMZ 5 is estimated at 3,107 (Apache Junction Fire District GIS and US Bureau of Census data).




City of Apache Junction and Pinal County boundaries (Source Apache Junction Fire District)

The areas at highest risk for wildland fires within the Apache Junction sub-WUI occur primarily along the slopes of the Superstition Mountains in the eastern portion of the sub-WUI and the Goldfield Mountains in the northern portion of the WUI. Vegetation associations within this sub-WUI range from desert scrub types on the desert floor to mixed desert shrub associations in the mountain foothills. These areas of the sub-WUI can create extreme risk during years of extraordinary rainfall. Analysis of fire-start data for the last 27 years (since 1980) indicates that the highest incidences of ignition occur within or adjacent to the sub-WUI either within or adjacent to the TNF lands along the northern and eastern portions of the sub-WUI. Because of the high/moderate risk rating for the majority (52%) of the Apache Junction sub-WUI and an elevated risk from the density of developed areas in proximity to high risk wildland fuels, the overall wildland fire risk rating of the sub-WUI is moderate.

Queen Valley Sub-WUI

Queen Valley sub-WUI is located in Township 1 South, Range 10 East, Sections 34 and 35 of Pinal County and has areas at high risk from brush fires around homes with a high density of brush growth on adjacent hillsides. The population of Queen Valley is reported to be slightly more than 800 residents. There are 595 housing units, of which 417 are classified as owner occupied. The Queen Valley Fire District has an ISO rating of 8b. The Queen Valley Fire District has designated five high-risk wildland fire areas within the community:

- Area 1 is about 0.25 mile long and is bounded by Queen Anne Drive to the east, East Victoria View to the south, Queen Valley Drive to the north, and North Charlotte Street to the west. This area has a westerly aspect and a 34 percent slope. The bottom of the slope is a xeroriparian area with heavy vegetative fuel loads and several undeveloped residential parcels with moderate to heavy fuels. Residences are located at the top of the slope, and vegetation overhangs some of the residential structures.
- Area 2 is bounded by West Morris Drive to the north, West Sahuaro Drive to the south, South Pomeroy Road to the west, and state lands to the east. Some lands in this area have a slope of over 60 percent with a northwest aspect. This slope has a moderate to heavy vegetative fuel growth and limited access, making hand-crew maintenance and wildfire suppression difficult; fire suppression would involve using large hand lines and smooth bore nozzles. Hydrants in the area have a capacity of 500 gallons per minute or less. Homes in this area have porches instead of yards. The initial attack plan consists of setting up a sprinkler system on the high-risk back porches to reduce stricter risk. All of the homes on West Sahuaro Drive are manufactured homes, most of them built in 1980.
- Area 3 is a large area of federal land in the southeast quarter of Section 34 that is bounded by East Silver King Road to the north, West Kirk Drive to the south, North Sharon Drive to the east, and El Camino Viejo to the far west. Residences are located within the south, east, and northern portions of the area. Queen Creek Wash bisects the area and is mostly composed of heavy xeroriparian vegetative fuels. The initial attack consists of having the local water company open and clear the two-track road running from Sharon Drive north to Silver King Road and then starting back burning at the east end of this area.
- Area 4 is bound by North Victoria View to the north and North Charlotte Street to the west, including North Elizabeth Street. This alignment is located within a xeroriparian area with residences immediately adjacent. The area also includes a gradual 65-foot elevation change on an east- and west-facing slope. Moderate to heavy fuels with a light base fuel in this area could act like a chute under certain winds, pushing the fire south through several structures and then toward state land.
- Area 5 is composed of North Cleopatra Street to the east, North Rita Avenue to the west, Queen Creek Drive to the north, and state trust lands to the south. The area includes a 64-foot gradual elevation change on a west-facing slope, from Rita Avenue to Cleopatra Street. Winds from the southeast would push the fire through homes on North Cleopatra Street and toward state trust lands.

The Queen Valley sub-WUI is primarily composed of areas at high risk from wildland fire during extreme rainfall years. The Queen Valley sub-WUI consist of a steadily rising elevation and areas of increasing slope from the lower elevations of Queen Valley to the foothills of the Superstition Mountains within the northern portion of the sub-WUI. Vegetation associations within this sub-WUI range from desert scrub types on the desert floor to mixed desert shrub and woodlands in the foothills of the Superstition Mountains. Although the majority (73%) of the Queen Valley sub-WUI has a moderate/low risk rating, the sub-WUI has an elevated risk from the density of developed areas in proximity to high-risk wildland fuels; therefore, the overall wildland fire risk rating of the sub-WUI is high.

### Superior Sub-WUI

The town of Superior is located on SR 60 at the junction of SR 177 and was established initially as a silver and copper mining community. Mining is still a significant employment sector, with the Magma Copper Mine being the states largest underground mine. The Oak Flats campground and Boyce Thompson Southwestern Arboretum are significant attractions near the community. Superior has identified three historic districts. The population of Superior has remained steady at just below 3,500 residents since 1990. The fire department provides structural and wildland fire response to over 1,470 housing units, with over 900 of these classified as owner occupied. The Superior Fire Department has an ISO rating of 7. The Superior sub-WUI is composed primarily of high wildland fire risk vegetation associations in conjunction with a steadily rising elevation and slope from south to north throughout the sub-WUI. Substantial threats to structure and infrastructure are found within and adjacent to the community. Several large wildfires have occurred within or adjacent to the community. The Superior sub-WUI does have increased high risk due to ignition history from the Boyce Thompson Southwestern Arboretum east and north along US 60 for the length of the sub-WUI. Vegetative associations within this sub-WUI range from desert scrub types on the desert floor to mixed desert shrub associations in the mountain foothills. These areas of the sub-WUI can create extreme risk during years of extraordinary rainfall. Analysis of fire-start data for the last 27 years (since 1980) indicates that the highest incidences of ignition occur within or adjacent to the sub-WUI either within or adjacent to TNF lands along the northern portion of the sub-WUI. The majority (79%) of the Superior sub-WUI has a high wildfire risk, with an elevated risk from a density of developed areas in proximity to high risk wildland fuels and elevated areas of risk in the Queen Creek riparian corridor; therefore, the overall wildland fire risk rating of the sub-WUI is high.

### Top of the World Sub-WUI

The Top of the World sub-WUI includes the unincorporated community of Top of the World and the Oak Flats area. Top of the World is a rural community located along US 60 near the Pinal County line. The community of Top of the World, listed as moderate risk within the Arizona-*Identified Communities at Risk* (Arizona State Forester 2007a), is located within the Top of the World sub-WUI. US 60 is the only transportation route for this community. According to 2000 census data, the population of the community of Top of the World is 330. There are 196 housing units, of which 47 are classified as owner-occupied units and 61 are classified as detached single-family units, while135 are classified as mobile homes. Top of the world is not within a fire district and therefore has an ISO rating of 10. The Top of the World sub-WUI is composed, almost exclusively, of areas at high wildland fire risk. Highest risk for wildland fires within the Top of the World sub-WUI is a result of the combination of volatile vegetative associations occurring in conjunction with southerly exposures of increasing steep slopes. These areas of the sub-WUI can create extreme risk during normal as well as during year of extraordinary rainfall. Analysis of fire-start data for the last 27 years (since 1980) indicates that the highest incidences of ignition occur within or adjacent to the sub-WUI either within or adjacent to the Tonto National Forest lands along the northern and eastern portions of the sub-WUI. The majority (97%) of the Top of the World sub-WUI has a high wildfire risk, with an elevated risk from ignition history in areas of high-risk wildland fuels; the overall wildland fire risk rating of the sub-WUI is high.

Golder Ranch Sub-WUI

This sub-WUI includes the developed areas in the Golder Ranch Fire District within Pinal County that were not incorporated into the *Catalina Community Wildfire Protection Plan* (2007). These include the Saddlebrook developments along SR 77, the Oracle Junction area, and developed parcels north along a segment of SR 79 northwest to the area above Three Buttes. Outside the Saddlebrook development, this sub-WUI is sparsely populated. However, areas of high risk occur along the Pinal-Pima county border and within the western portion of the sub-WUI toward the Tortolita Mountains as well as throughout the WUI where desert shrub-scrub associations occur in conjunction with southerly exposed slopes of greater than 20 percent. Additionally, there are several large and converging xeroriparian areas of elevated concern of wildland fire risk that occur within the WUI. The majority (84%) of the Golder Ranch sub-WUI is rated as low risk; however, with an elevated risk from a density of developed areas in proximity to high-risk wildland fuels and elevated areas of risk from several xeroriparian areas, the overall wildland fire risk rating of the sub-WUI is moderate.

**2. Western WUI Communities**

Avra Valley Sub-WUI

This sub-WUI includes the communities and isolated private lands along the I-10 corridor. These include the communities of Red Rock and Picacho and the Picacho Peak State Park, all of which are located within the lower Santa Cruz River Valley. Local sources estimate the combined population of these communities at 1,785. The US Census Bureau and Department of Economic Security do not report population figures for this area. The Avra Valley Fire District was formed in 1977 to ensure the safety to these communities. The fire district employs 23 full-time and 20 reserve firefighters. Fire stations within the fire district are staffed 24 hours with professional firefighters trained in both structural and wildfire response. The fire district encompasses over 265 square miles across Pinal and Pima Counties and serves nearly 10,000 residents within the combined counties. Areas of high risk from wildland fire occur on the southern and western portion of this sub-WUI in proximity to the foothills of the Sacaton Mountains, as well as the foothills area of Picacho Peak within and adjacent to the Picacho Peak State Park. During extreme rainfall years, increased production of fine fuels from invasive annual forbs (pigweed) and grasses (Mediterranean grass) as well as the continually increasing invasion of perennial grasses, such as buffelgrass, creates areas of high risk during spring/summer drought months in areas of increasing slope and southerly exposures. Due to a low wildfire risk for the majority (94%) of the sub-WUI, a low to moderate ignition history, and a low to moderate density of community values, the overall wildland fire risk rating of the sub-WUI is low.

Casa Grande sub-WUI

The Casa Grande sub- WUI includes the incorporated city of Casa Grande and areas outside the fire department south to the I-10/I-8 interchange, north along the I-10 corridor to the crest of the Sacaton Mountains, and just west of the Greene and Santa Rosa Washes. The Union Pacific Railroad traverses the WUI north to south. There are several large xeroriparian areas, including Santa Rosa Wash, Greene Wash, and the Casa Grande Canal downstream of the Picacho Reservoir, within this sub-WUI that are considered areas of elevated wildland fire concern. This is a rural-to-urban community located along I-10 between

Tucson and Phoenix. I-10 and SR 84 are major transportation routes for this city. Additionally, several state routes and local roads feed into and out of the city. According to 2000 census data, the population of Casa Grande is 25,224 (2007 estimates: 42,422). There are 10,936 housing units, of which 4,394 are classified as owner-occupied units and 5,788 are classified as detached single-family units. The Casa Grande Fire Department has an ISO rating of 4 or 9. The majority of the Casa Grande sub-WUI is classified as low wildland fire risk. The relatively flat landscape composed of desert scrub-shrub vegetative communities that dominate the landscape is not conducive to intensive wildland fire due to noncontiguous aerial or ground fuels. However, during extreme rainfall years, abundant annual and invasive grasses can create areas of high risk within the foothills of the Sacaton and Casa Grande Mountains as well as within the major xeroriparian areas within the sub-WUI. Due to a low wildfire risk for the majority (87%) of the sub-WUI, a low to moderate ignition history, and a low to moderate density of community values, the overall wildland fire risk rating of the sub-WUI is low.

Coolidge Sub-WUI

The Coolidge sub-WUI includes the incorporated city of Coolidge and developed and agricultural lands surrounding the city. This is a rural city located along SR 87 and SR 287 east of Casa Grande. SR 87 and SR 287 are the major transportation routes for the city; SR 87 connects to I-10 to the south at Eloy and connects to SR 587 (Arizona Avenue) northwest of Coolidge. Additionally, numerous local roads feed into and out of the city. The Union Pacific Railroad traverses the WUI north to south. The Coolidge Fire Department provides fire protection to 10,800-plus residents and covers an area of 65-plus square miles within this sub-WUI. The fire department currently responds from two stations and is staffed by a combination of fully and partially paid and firefighters. According to 2000 census data, the population of Casa Grande is 7,786 (2007 estimates: 11,721). There are 3,179 housing units, of which 1,459 are classified as owner-occupied units and 2,108 are classified as detached single-family units. The majority of open lands within the sub-WUI are agricultural lands. Coolidge has been the center of Arizona's cotton industry, and agriculture remains a significant economic component of the city. The majority of the sub-WUI is classified as low risk of wildland fire. The relatively flat landscape composed of desert scrub-shrub vegetative communities that dominate the landscape is not conducive to intensive wildland fire due to noncontiguous aerial or ground fuels. However, during extreme rainfall years, abundant annual and invasive grasses can create areas of high risk within the southern foothills of the Sacaton Mountains in the northeastern portion of the WUI. Due to a low wildfire risk for the majority (86%) of the sub-WUI, a low to moderate ignition history, and a low to moderate density of community values, the overall wildland fire risk rating of the sub-WUI is low

Queen Creek Sub-WUI

The Queen Creek sub-WUI includes the San Tan Mountain Regional Park and the portion of the incorporated town of Queen Creek that lies within Pinal County; much of Queen Creek is within Maricopa County, and this portion was not included in the analysis. Queen Creek is easily accessible from many directions and has easy access to US 60 to the north and I-10 to the west. The WUI includes a portion of the Union Pacific Railroad. According to 2000 census data, the population of Queen Creek was 4,316 residents. The 2007 census population estimate is 23,610, with 1,255 residents residing in Pinal County. In 2000, there were 3,179 housing units, of which 1,459 are classified as owner-occupied units and 2,108 are

classified as detached single-family units. The southern and western portion of the sub-WUI does support high-risk vegetative associations during extreme rainfall years. During years of above-normal rainfall, the production of annul forbs and invasive grasses (Mediterranean grass) and increasing perennial grass invasions (buffelgrass) in conjunction with steep slopes on southern exposures can create areas of extreme risk during premonsoonal drought periods. There areas of within the sub-WUI that are classified as high risk from wildfire fire ignition history. The combination of high risk due to vegetation, topography, and history of wildfire ignitions show significant areas of the eastern portion of the sub-WUI to be at high risk from wildland fire. The majority of the relatively flat landscape composed of desert scrub-shrub vegetative communities that dominate the eastern half of the sub-WUI is not conducive to intensive wildland fire due to noncontiguous aerial or ground fuels and does not have a history of high wildland fire ignitions. Due to a low wildfire risk for the majority (78%) of the sub-WUI, a low to moderate ignition history, a moderate density of community values, and proximity to the San Tan Mountain Regional Park, the overall wildland fire risk rating of the sub-WUI is low.

Eloy Sub-WUI

The Eloy WUI includes the incorporated city of Eloy and adjacent lands outside the fire district, including the communities of Arizona City and Toltec. Structural and wildland fire protection for these communities is from the Eloy and Arizona City Fire Districts. This sub-WUI is primarily composed of rural communities located along I-10 and SR 87 south of Casa Grande and encompasses a low to moderate population density. I-10 is the major transportation route for the communities; SR 87 provides access to the communities and connectivity to communities to the north. Additionally, numerous local roads feed into and out of the communities. The Union Pacific Railroad parallels SR 87 through the sub-WUI. According to 2000 census data, the population of Eloy is 10,375 (2007 estimates: 13,953). There are 2,737 housing units, of which 1,007 are classified as owner-occupied units and 1,558 are classified as detached single-family units. Arizona City is a planned community at the midpoint of the Phoenix-Tucson I-10 corridor. The area supports industrial, commercial, and residential developments. The community was established in 1960 and has not been incorporated. The community also includes a 48-acre lake available for recreational boating and fishing. The estimated population of the Arizona City area from the 2000 census is 4,385. The Eloy sub-WUI is located within the Santa Cruz Flat, which is composed of desert scrub-shrub vegetative communities that dominate the landscape and that are not conducive to intensive wildland fire due to noncontiguous aerial or ground fuels. Additionally, this sub-WUI has a history of low numbers of wildland fire ignitions. The Eloy sub-WUI includes the area surrounding the, primarily private, developed and agricultural lands that include the community of La Palma, which is located between the municipalities of Coolidge and Eloy. This sub-WUI also includes Picacho Reservoir and associated adjacent lands. There are no major communities within this portion of the sub-WUI, and the number of households in the census block is reported as low to moderate. Areas of highest wildfire risk are located on the eastern portion of the area within the foothills of the northern extension of the Picacho Mountains and in the riparian habitats within the Picacho Reservoir and its associated canals and drainages. This portion of the sub-WUI does include areas of moderate risk based on wildfire ignitions within the northern extension of the Picacho Mountains. Due to a low wildfire risk, a low ignition history, and a low to moderate density of community values, the overall wildland fire risk rating of the sub-WUI is low.

### Maricopa Sub-WUI

The Maricopa WUI includes the municipality of Maricopa and the community of Stanfield, as well as developed and agricultural lands surrounding the communities. The Ak-Chin Indian Community is located between the communities of Maricopa and Stanfield. Maricopa and Stanfield are rapidly growing communities—expanding from slightly less than 1,500 residents in 2000 to over 32,000 residents in 2007. The communities are located south of I-10 and north I-8, in western Pinal County. Maricopa serves as a bedroom community for the Greater Phoenix Valley communities. Although the communities have primarily been agricultural, they are expanding to include housing and light industry; for example, Volkswagen and Nissan have recently established automobile proving grounds in the communities. SR 84, SR 347, and SR 238 are the primary routes for the communities, with I-10 and I-8 as the major transportation routes north and south of the communities. The Union Pacific Railroad parallels SR 238 through the sub-WUI. According to 2000 census data, the population of Maricopa is 1,482 (2007 estimates: 32,157). In 2000, there were 286 housing units. The 2000 census data estimates the population of the Stanfield area at 651, with 202 total housing units. Structural and wildland fire protection is provided to the communities by the Maricopa Fire Department and the Stanfield Fire District. The Maricopa sub-WUI is located within the relatively flat low valleys of the Santa Cruz River Valley and the Santa Rosa and Greene wash drainages. This low desert valley area is composed of desert scrub-shrub vegetative communities, which dominate the landscape and are not conducive to intensive wildland fire due to noncontiguous aerial or ground fuels. However, in extreme rainfall years significant ground fuels are produced within the foothills of the Sacaton Mountains on the eastern portion of the WUI and also within the foothills of the Table Top Mountains along the south and southwest corner of the Pinal County CWPP WUI boundary; these conditions create areas of high risk within southerly exposed steep slopes. However, this sub-WUI does not have a history of a high number of wildland fire ignitions. The majority of the sub-WUI has a moderate population density. Due to a low wildfire risk, a low ignition history, and a moderate density of community values, the overall wildland fire risk rating of the sub-WUI is low.

### Florence Sub-WUI

The Florence sub-WUI includes the municipality of Florence and surrounding primarily private, agricultural, and developed lands. The sub-WUI includes portions of the Gila River and Florence–Casa Grande Canal riparian corridors. Florence is the capital seat of Pinal County, located on SR 79 and SR 287 west of I-10 approximately 61 miles southeast of Phoenix and 70 miles northwest of Tucson. Florence is the fifth oldest town in Arizona, with the downtown center designated as an official historic district. One of Arizona's state prison complexes is located in Florence. The population of Florence has grown from 14,466 residents in 2000 to approximately 22,000 in 2007. The Florence sub-WUI is located within the relatively flat lowlands of the Gila River Valley, The vegetation of the sub-WUI ranges from desert scrub-shrub communities (primarily creosotebush flats), which dominate the landscape and are not conducive to intensive wildland fire due to noncontiguous aerial or ground fuels, to upland Sonoran desert shrub communities, which during extreme rainfall years can produce abundant light fuels from invasive annual and perennial grasses. In extreme rainfall years significant ground fuels are produced within the bajadas of the western slopes of the Tortilla Mountains and the ascending slopes north of the community to the Mineral Mountain and White Canyon Wilderness area, which create areas of high risk to wildland fire within southerly exposed steep

slopes. The Florence sub-WUI does not have a history of a high number of wildland fire ignitions. The majority of the sub-WUI has a high population density. Due to a low wildfire risk, a low ignition history, and a high density of community values, the overall wildland fire risk rating of the sub-WUI is moderate.

Ak-Chin Indian Community Sub-WUI

The Ak-Chin Indian Community sub-WUI is restricted to tribal trust lands within the Pinal County CWPP. The Ak-Chin Indian Community comprises 21,840 acres approximately 30 miles south Phoenix. It is situated in the Santa Cruz Valley, a nearly flat landscape of deep sandy soils composed primarily of lower-elevation desert scrub-shrub vegetative communities. The community of Maricopa Colony, listed as low risk within the Arizona-*Identified Communities at Risk* (Arizona State Forester 2007a) is located within the Ak-Chin sub-WUI. Land use within the Ak-Chin sub-WUI is primarily agricultural and, when at full operation, will consist of approximately 16,000 acres of cultivated lands. Additionally, the Ak-Chin Indian Community owns a 109-acre industrial park constructed in 1971. Major transportation corridors for the community include SR 238, which intersects the community at the northeast corner, and SR 347, which bisects the community connecting I-8 and I-10. According to the 2000 US census data, the population of the Ak-Chin Indian Community is 742, with 234 total housing units. Structural and wildland fire protection is provided by the Ak-Chin Fire Department. The Ak-Chin Fire Department has identified areas of elevated concern due to wildland vegetative fuels in proximity to residential and community structures. These identified areas are of highest treatment priority within this sub-WUI and are identified on the enclosed aerial photo.

The vegetation of the sub-WUI is composed primarily of desert scrub-shrub vegetative communities. Creosotebush flats dominate the landscape and are not conducive to intensive wildland fire due to noncontiguous aerial or ground fuels. However, during extreme rainfall years the deep loamy soils can produce abundant light flues from invasive annual and perennial grasses. In extreme rainfall years significant ground fuels are produced within the identified areas of concern, creating isolated areas of high risk. The Ak-Chin sub-WUI does not have a history of a high number of wildland fire ignitions. The majority of the sub-WUI has a low population density. Due to a generally low wildfire risk, a low ignition history, and a low density of community values, the overall wildland fire risk rating of the sub-WUI is low.


Ak-Chin Indian Community (Source: Ak-Chin Indian Community Fire Department)

Gila River Indian Community Sub-WUI

The Gila River Indian Community consists of 372,000 acres approximately 25 miles south of Phoenix and 70 miles north of Tucson. The tribal administrative offices and departments are located in Sacaton, Arizona, and serve residents within seven community districts. The community of Santa Cruz, listed as moderate risk within the Arizona-*Identified Communities at Risk* (Arizona State Forester 2007a), and is located adjacent to the Gila River within the Gila River sub-WUI. The principal land use within the sub-WUI is agricultural, with steadily increasing industrial, retail, and recreational development. The community owns and operates three industrial parks—the Lone Butte Park is considered one of the most successful tribal industrial parks. Structural and wildland fire protection is provided to the communities by the Gila River Fire Department. The 2000 US Census reported the population of the Gila River Indian Community at 11,257. The vegetation of the sub-WUI consists primarily of desert scrub-shrub vegetation associations. Creosotebush flats dominate the upland landscape and are not conducive to intensive wildland fire due to noncontiguous aerial or ground fuels. However, during extreme rainfall years the deep loamy soils can produce abundant light fuels from invasive annual and perennial grasses. The highest wildland fire risk within the sub-WUI is related to the Gila River riparian corridor that has been heavily invaded by saltcedar. Wildland fires within dominant stands of saltcedar can burn at high intensities and have relatively high rates of spread. During normal burning conditions, fire brands will commonly move in excess of 700 feet in front of the headfire. The Gila River sub-WUI does have a history of a high number of wildland fire ignitions. Many of these ignitions have occurred within agricultural lands and are consistent with normal agricultural practices. However, ignitions, whether natural or human caused, within proximity to the riparian corridor have the potential to create unwanted wildfire. Wildfires that occur within riparian corridors can have significant watershed and community water supply impacts due to ash, increased heavy metals, and soil erosion following extreme wildfire behavior that removes vegetative cover. The majority of the sub-WUI has a low to moderate population density. Due to a generally low upland and high riparian wildfire risk, a high ignition history, and a low to moderate density of community values, the overall wildland fire risk rating of the sub-WUI is moderate.

Tohono O'odham Nation Sub-WUI

The Tohono O'odham Nation is located in the southern portion of the Pinal County CWPP and includes the tribal community of Chuichu. Chuichu is primarily an agricultural community located adjacent to Greene Wash. The 2000 US Census reports the population of Chuichu at 339, with 88 total housing units. The sub-WUI has a low population density. Structural and wildland fire protection for the community is provided by the Tohono O'odham Fire Department. The Greene Wash riparian corridor is a major drainage originating in Aguirrie Valley and flowing through the Santa Cruz Valley along the eastern foothills of the Sawtooth Mountains to its confluence with the Gila River to the north. The riparian corridor does, under normal rainfall years, produce significant amounts of fine and moderate fuel within areas heavily vegetated with perennial grasses, such as cane canary grass, and areas of heavy fuels from deciduous desert riparian vegetation. The upland vegetation associations of the sub-WUI include desert scrub composed of creosotebush associations and shrub associations consisting of Sonoran-Paloverde mixed cacti associations. Creosotebush flats, which dominate the nearly level lower-elevation valley floor, are not conducive to intensive wildland fire due to noncontiguous aerial or ground fuels. Upland shrub associations, during extreme rainfall years, can produce abundant light fuels from invasive annual and perennial grasses. The highest wildland fire risk within the sub-WUI is related to the Greene Wash xeroriparian corridor that has been invaded by annual and perennial grasses and saltcedar. The Tohono O'odham sub-WUI does not have a history of a high number of wildland fire ignitions. Due to a generally moderate upland and high xeroriparian wildfire risk, a low ignition history, and a low density of community values, the overall wildland fire risk rating of the sub-WUI is moderate.

### 3. Cumulative Risk Analysis

The cumulative risk analysis synthesizes the risk associated with fuel hazards, wildfire ignition points, wildfire occurrence, and community values. These different components were analyzed spatially, and an overall cumulative risk for the WUI was calculated. Table 2.7 and Figure 2.8 display the results of the cumulative risk analyses, identifying the areas and relative percentages of WUI areas of high, moderate, and low risk.

Table 2.7. Cumulative risk levels by percentage of the WUI area

| Pinal County CWPP community sub-WUI | High risk (%) | Acres | Moderate risk (%) | Acres | Low risk (%) | Acres | Total acres |
|---|---|---|---|---|---|---|---|
| Apache Junction | 23 | 9,292 | 29 | 11,780 | 48 | 19,633 | 40,705 |
| Queen Valley | 27 | 15,426 | 4 | 2,289 | 69 | 39,141 | 56,856 |
| Superior | 79 | 33,294 | 5 | 2,303 | 16 | 6,740 | 42,337 |
| Top of the World | 97 | 13,788 | 1 | 202 | 2 | 261 | 14,251 |
| Kearny | 56 | 34,580 | <1 | 252 | 44 | 27,245 | 62,077 |
| Dudleyville | 27 | 13,984 | 2 | 920 | 68 | 36,602 | 51,506 |
| Mammoth | 27 | 8,237 | 1 | 318 | 72 | 22,090 | 30,645 |
| Galiuro Mountains | 67 | 64,385 | 2 | 1,481 | 31 | 29,337 | 95,203 |
| San Manuel | 22 | 21,319 | <1 | 298 | 78 | 74,745 | 96,362 |
| Oracle | 34 | 14,139 | 4 | 1,619 | 62 | 25,635 | 41,393 |
| Golder Ranch | 15 | 16,699 | 1 | 1,090 | 84 | 91,291 | 109,080 |
| Avra Valley | 5 | 12,979 | 1 | 4,644 | 94 | 256,109 | 273,732 |
| Eloy | 4 | 4,679 | 4 | 5,204 | 92 | 113,605 | 123,488 |
| Casa Grande | 8 | 11,963 | 5 | 8,440 | 87 | 135,282 | 155,685 |
| Coolidge | 8 | 6,195 | 6 | 4,495 | 86 | 65,108 | 75,798 |
| Florence | 4 | 6,790 | 3 | 4,097 | 93 | 140,105 | 150,992 |
| Queen Creek | 8 | 6,177 | 16 | 11,012 | 78 | 60,433 | 77,622 |
| Maricopa | 9 | 15,515 | 10 | 17,995 | 81 | 143,583 | 177,093 |
| Gila River Indian Community | 52 | 145,607 | 12 | 34,457 | 35 | 98,901 | 278,965 |
| Ak-Chin Indian Community | 1 | 153 | 5 | 951 | 94 | 20,026 | 21,130 |
| Tohono O'odham Nation | 30 | 3,279 | 7 | 807 | 63 | 7,072 | 11,158 |
| **Total** | 23 | 458,479 | 6 | 114,654 | 71 | 1,412,944 | 1,986,077 |

*Source*: Logan Simpson Design Inc.

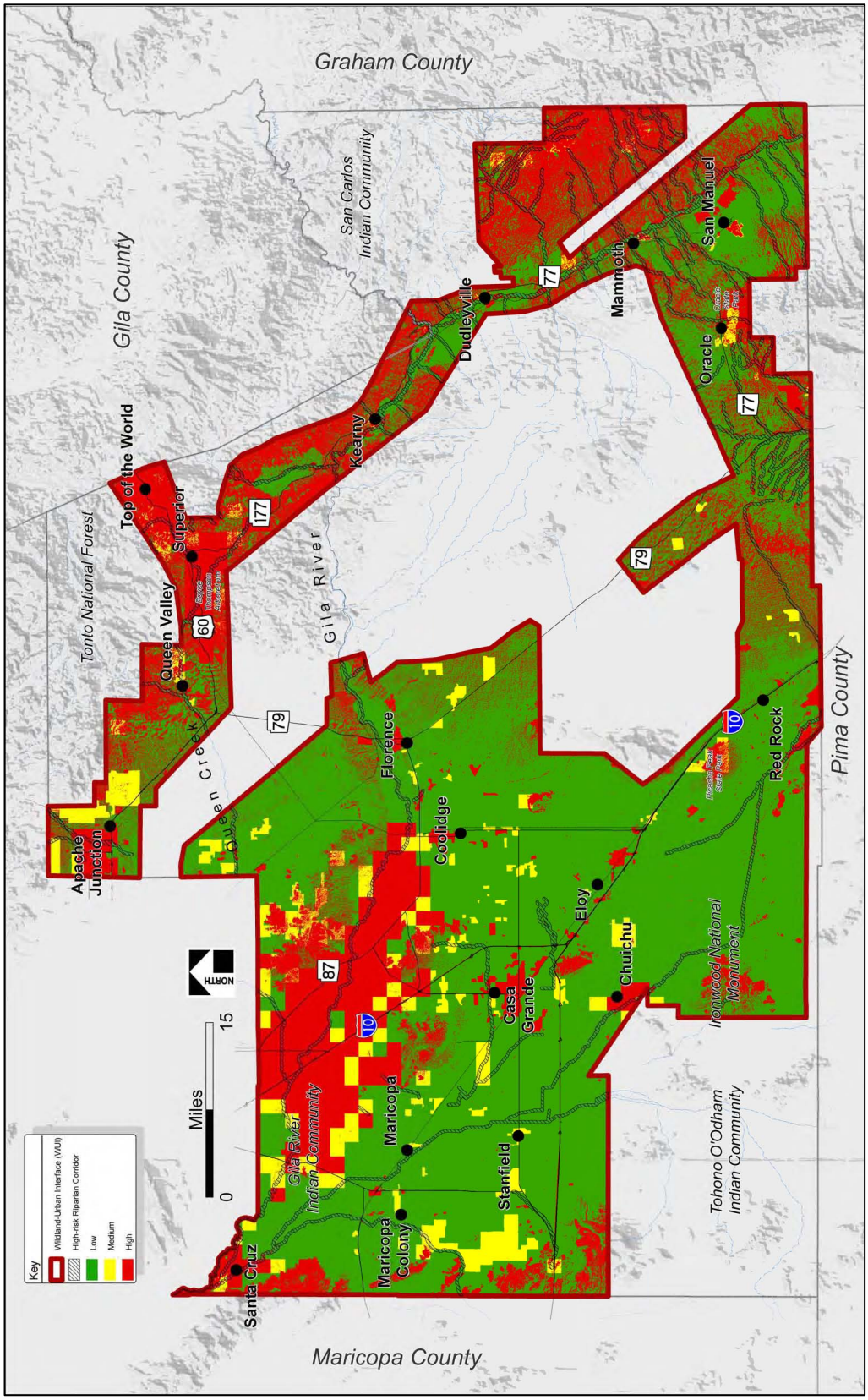



**Figure 2.8.** Pinal County CWPP Cumulative Risk Analysis

# III. COMMUNITY MITIGATION PLAN

This section outlines Pinal County CWPP priorities for wildland fuels treatments as well as the recommended methods of treatment and management strategies for mitigating the potential spread of catastrophic wildland fire throughout the WUI. This section also presents recommendations for enhanced wildland fire protection capabilities and public education, information, and outreach.

## A. Fuel Reduction Priorities

After determining the areas at greatest risk for wildland fire (Section II of this CWPP), the Core Teams developed a series of proposed actions, including residential treatments; a series of firebreaks appropriate for the wildland fuel types; and fuel mitigation treatments for undeveloped landscape areas (Table 3.1). The Core Teams have proposed wildland fire mitigation projects for at-risk public and private lands. These proposed actions are recommended to prevent wildfire spread from public lands onto private land and, conversely, to reduce the risk of fires spreading from private land onto public lands by reducing wildland fuels and creating a defensible space for wildland firefighters. A primary goal of the Pinal County CWPP is for proposed treatments to be continuous across property boundaries, allowing for the most effective protection from wildfires.

Hazardous fuels reduction recommendations on public lands vary by constituting either a single firebreak in appropriate width and length within the WUI or broader land treatment applications of wildland fuel reduction and habitat restorations within the WUI. Additional firebreaks or hazardous fuels reduction projects may be developed over time and will conform to the types of treatment recommendations developed by the Core Teams. The PCOEM, ASFD, CNF, TNF, tribal and local fire departments and districts, and the Core Teams' participating resource specialists developed firebreak recommendations by vegetative fuel types. These recommendations are based on firebrand movement during the peak fire season under normal seasonal weather conditions in relation to slope and fuel type. The recommended land treatments and fuelbreaks will enhance public and firefighter safety, provide for community value protection, enhance restoration of native vegetation, and provide for wildlife habitat needs. Several designated wilderness areas are within or adjacent to the Pinal County CWPP WUI: Superstition, Table Top, Aravaipa Canyon, and White Canyon wilderness areas. Wildland fuel mitigation treatments within wilderness areas will be conducted by BLM and TNF under appropriate wilderness regulations. The Core Teams may recommend fuelbreaks along specific identified private in-holdings adjacent to wilderness boundaries to allow BLM to use appropriate management response (Appendix F).

The wildland vegetative fuel and firebreak recommended treatments meet the Pinal County CWPP goals of enhancing firefighter and public safety, reducing hazardous wildland fuels on public and private lands, improving fire prevention and suppression, restoring riparian and rangeland health, involving the community, and expediting project implementation. To prioritize wildland fuel mitigation projects, the Core Teams analyzed wildland fuel hazards, fire history, and community values. This combined risk assessment was compiled in a single community map that depicts areas of low-, moderate-, and high-risk evaluations (Figure 2.8). These risk areas were further identified and categorized into a total of 153 management site-specific areas (treatment management units) of the WUI, with an overall risk value determined for each management area (Figure 3.1).

**Table 3.1.** Fuel modification and treatment plans

| Treatment No. | 1 | | | | 2 | | 3 | | 4 | |
|---|---|---|---|---|---|---|---|---|---|---|
| | Developed private parcels <2 acres | | | | Undeveloped private parcels or single-structure parcels >2 acres | | Grassland firebreaks | | Oak/pinyon/juniper and shrublands within the WUI | |
| **Treatment category** | **Zone 1 (0–10 feet from structures)** | **Zone 2 (10–30 feet from structures)** | **Zone 3 (30–100 feet from structures)** | **Zone 4 (100–600 feet around home)** | **Slopes <20%** | **Streambeds, channels, and slopes ≥20%** | **Slopes <20%** | **Slopes ≥20%** | **Landscape treatment outside firebreaks** | **Firebreaks** |
| **Vegetation** | Remove ladder fuels by pruning the lower third of trees or shrubs up to a maximum of 10 feet to reduce flammable vegetation.<br>Remove and destroy insect-infested, diseased, and dead trees and shrubs.<br>Grasses and forbs may be cut with a mower to a 4-inch stubble.<br>Remove dead plant material from ground; prune tree limbs overhanging roof; remove branches within 10 feet of chimney; remove flammable debris from gutters and roof surfaces. | Remove ladder fuels by pruning the lower third of trees or shrubs up to a maximum of 10 feet; remove and destroy insect-infested, diseased, and dead trees.<br>Create separation between trees, tree crowns, and other plants based on fuel type, density, slope, and other topographical features.<br>Reduce continuity of fuels by creating a clear space around brush or planting groups.<br>Grasses and forbs may be cut with a mower to a 4-inch stubble.<br>All snags and vegetation that may grow into overhead electrical lines, other ground fuels, ladder fuels, dead trees, and thinning from live trees must be removed. | Remove ladder fuels by pruning the lower third of trees or shrubs up to a maximum of 10 feet; remove and destroy insect-infested, diseased, and dead trees.<br>Maximum density of trees (whichever is greater: 60 BA at 80–100 trees/acre *or* average density of 100 trees/acre).<br>Grasses and forbs may be cut with a mower to a 4-inch stubble. | For natural areas, thin selectively and remove highly flammable vegetation.<br>Carefully space trees; choose Firewise plants.[a] | Remove ladder fuels by pruning the lower third of trees or shrubs up to a maximum of 8 feet; remove and destroy insect-infested, diseased, and dead trees.<br>Maximum density of trees (whichever is greater: 60 BA at 80–100 trees/acre *or* average density of 100 trees/acre)<br>See fuel modification plan (this section) developed to promote riparian health, to prevent spread of fire to adjacent property, and to create defensible space with considerations for wildlife and groundwater protection.<br>Single structure or structures on parcels exceeding 2 acres should include Treatment 1 in proximity to structures and Treatment 2 for remaining acres. | Remove dead, diseased, and dying trees. Fell dead trees away from stream channels with defined bed and banks.<br>Areas should be hand-thinned and hand-piled; inaccessible areas may be treated with periodic Rx.<br>Develop fuel modification plan (this section) for treatments. | Grassland types may be mechanically treated, including mowing, chopping, or mastication, to reduce or remove vegetation or may be grazed to a stubble height. Ensure that removal of vegetation within a designed firebreak of >1 chain (66 feet) in width and length is sufficient to protect federal, state, or private land values.<br>Fuel reduction treatments within grassland vegetation types may include multiple-entry burns to maintain stand structure and reduce fine fuels. Trees and shrubs >8 inch drc should be thinned to a variable distance of 15–35 feet between trees. Trees and shrubs <8 inches drc should be removed.<br>Mechanical/chemical or grazing treatment may be used to maintain firebreaks on private lands.<br>See the fuel modification plan (this section) developed to prevent spread of fire to adjacent property and to create defensible space with considerations for wildlife and groundwater protection. | Same as for slopes <20%. Fuel treatments may require hand-thinning and hand-piling or grazing in steep slopes. Rx may be used to reduce high fire potential (see Treatment 5). Designated firebreaks may be increased to no more than 2 chains in steep slopes where herbaceous (fine fuels) and subshrub species fuel loads increase to pretreatment levels within 3 years.<br>See fuel modification plan (this section) developed to promote forest health, to prevent spread of fire to adjacent property, and to create defensible space with considerations for wildlife and groundwater protection. | Spacing may be variable with a 20- to 35-foot minimum to promote (1) wildlife habitat while breaking horizontal fuel loading, which allows for patches of closely spaced trees for adequate cover, and (2) other habitat components while incorporating openings to increase herbaceous forage production, to maximize edge effect, and to promote fire-resilient stands. Mechanical thinning and Rx (see Treatment 5) can be used to reduce vegetative fuels and move stands toward potential natural vegetation groups as described in the *FRCC Interagency Handbook* (FRCC Interagency Working Group 2005a) or grazed to like conditions. All trees >10 inches drc will be targeted as "leave trees" unless removal is necessary to achieve the desired spacing. | Woodland and shrub trees <8 inches drc will be thinned to a spacing of 15 feet between trees, or Rx will be applied to achieve like conditions. Shrub and tree trunks will be severed <4 inches from the ground. Mechanical treatments, such as crushing, chipping, mastication, and Rx, may be used to create open stands that produce flame lengths of ≤4 feet to minimize crown-fire potential and producing vegetative fuel conditions conducive to suppression action. Herbaceous and subshrub understory may be mechanically treated, including mowing, chopping, and masticating, or grazed to limit fine-fuel loading while protecting soil integrity from rainfall runoff. |
| **Slash** | Remove or reduce natural flammable material 2–4 feet above the ground around improvements. Remove vegetation that may grow into overhead electrical lines, ladder fuels, and dead trees. Thinning from live trees must be removed (chipped, etc.). Remove all leaf litter to a depth of 1 inch. | Control soil erosion from small waterflow channels by using rock or noncombustible velocity-reducing structures.<br>Remove all leaf litter to a depth of 1 inch. | Same as Zones 1 and 2. | Slash may be burned, piled and burned, or chipped and removed. Slash from grassland treatments may be burned, removed, masticated, turned, or grazed for like treatment. | All slash, snags, and vegetation that may grow into overhead electrical lines; other ground fuels; ladder fuels; dead trees; and thinning from live trees must be removed, mechanically treated (chipped, etc.), or piled and burned along with existing fuels. | Clean dead and down debris in channels where debris may be mobilized in floods, thus creating downstream jams.<br>Some slash and debris can be scattered and retained in small, ephemeral streambeds in which slash can help retain runoff and sediment and provide headcut stabilization. | Slash from grassland treatments may be burned, removed, masticated, or turned (disked). | Same as for slopes <20%; however, slash may be hand-piled and ignited with Rx as the primary slash reduction treatment. | Slash may be burned, piled and burned, or chipped and removed. Slash from grassland treatments may be burned, removed, masticated, or turned. | Slash may be burned, piled and burned, or chipped and removed. Slash from grassland treatments may be burned, removed, masticated, or turned. |

*Continued*

**Table 3.1.** Fuel modification and treatment plans

| Treatment No. | 5 | 6 | 7 | | 8 | 9 |
|---|---|---|---|---|---|---|
| | **Prescribed fire** | **Escape and resource transportation corridors (federal and nonfederal lands)** | **Riparian areas (federal, nonfederal, and private lands)** | | **Conditional suppression areas (federal and nonfederal lands)** | **Saltcedar removal for restoration purposes (federal and nonfederal lands)** |
| **Treatment category** | **Federal, state, or private lands** | **Federal, state, or local government where designated as escape route** | **Federal or state lands** | **Firebreaks on private lands** | **Federal, state, or private lands** | **Federal, state, or private lands** |
| **Vegetation** | Rx will be used as a tool to accomplish specific resource management objectives in accordance with ASLD, ASFD, CNF, TNF, and/or BLM standards and guides.<br>Rx on federal land is authorized if part of an approved Rx burn plan. As additional areas within the WUI are identified, Rx may be used as a treatment tool provided that a wildland fire implementation plan is in effect and that all conditions set forth have been met.<br>Rx can occur at low, moderate, and high intensity. High-intensity fire will be used to create openings by removing all aboveground vegetation. | Reduce fuel loading by thinning trees <10 inches drc. Reduce trees to 15-foot spacing. Shrub and tree trunks will be cut no less than 4 inches from the ground. Stands will be variable across the landscape, such as retention of bands of higher-density vegetation with sufficient understory to maintain functionality of important wildlife movement corridors in areas of low structure density.<br>Mechanical treatments may include chipping, piling and burning, or removal and Rx in the project area.<br>Trees may be left in clumps with fuel ladders removed from below. Dead, diseased, and dying trees of all sizes will be emphasized for removal. Some trees >8 inches drc may be cut to reduce safety hazards or when needed to reach desired 15-foot spacing.<br>Escape and resource transportation corridors may serve as firebreaks in all vegetative types.<br>Firebreaks for each vegetative type, as described in this table, would be implemented at appropriate distance from the centerline of the escape and resource transportation corridors to produce fire-resilient stands and to enhance evacuation and response access.<br>Emphasis will be placed on removing nonnative and flammable species.<br>Grasses and forbs may be cut with a mower to 4-inch stubble. | Riparian treatments will be limited in scope. The majority of riparian areas that fall within the WUI boundary will be avoided unless deemed a fuel hazard.<br>Clearing or cutting of any material by mechanized equipment within 10 feet of any stream on federal land may be prohibited to prevent the risk of accelerating erosion.<br>Treatments may include some overstory removal of deciduous riparian trees and shrubs in areas where encroachment has increased heavy woody fuels (emphasizing removal and control of saltcedar and other invasive trees).<br>Treatments will emphasize nonnative species. Snags >8 inches may be retained. All presettlement trees, including snags, will be targeted for retention.<br>Restricting the removal of the vegetative overstory in the riparian areas to the period of October 15–March 31 will prevent the disturbance of any nesting by neotropical migrant bird species, including the southwestern willow flycatcher. Fuels reduction should occur October 15–March 31 in riparian areas, as long as fire danger is not extreme.<br>Emphasis will be placed on removing species listed in Appendix A. | Private land treatment should use hand tools, chain saws, or mowers. Dead vegetation and slash should be removed. Ladder fuels, including limbs and branches, should be removed up to a maximum of 8 feet aboveground.<br>All mechanized equipment must meet state and local fire-department/district standards. Perform treatments October–March annually. Treatment of annuals may be best when annuals are green. | This prescription includes lands with desert shrub/scrub vegetative types in which no fuel modification treatments have been identified as necessary to provide protection from wildland fire. The threat from catastrophic wildland fire is low or nonexistent. This includes areas in which fire never played a historical role in developing and maintaining ecosystems. Historically, in these areas, fire return intervals were very long. These are areas in the WUI in which fire could have negative effects unless fuel modifications take place. These include areas in which the use of fire may have ecological, social, or political constraints and areas in which mitigation and suppression are required to prevent direct threats to life or property. Wildland fire growth within these areas will be monitored for private property, ecological, and cultural threats before initiating suppression. Agency and fire-department/district policy provisions will determine suppression response. | Areas of monotypic saltcedar or in mix with mesquite or other riparian tree species may be treated mechanically or chemically or by controlled burning and reburning to reduce stem density, canopy, and excessive fuel loading. Mechanical removal for saltcedar by cutting below the root collar during November–January is preferred. Mechanical whole-tree extraction has achieved as high as 90% mortality on initial treatments and may be considered a preferred treatment. Low-volume oil-based herbicide applications in late spring through early fall would be considered for controlling small plants (<2 inches drc). Low-volume cut-stump herbicide applications will be considered in combination with mechanical treatment. Preferred phenological stage for burning is peak summer months and postavian breeding months. Black lines and appropriate headfires should be initiated depending on site-specific vegetative and burning conditions. Maintenance, revegetation, restoration, and monitoring should follow as needed for each treatment area. |
| **Slash** | Slash, jack piles, and down logs may be burned as appropriate in consideration of local conditions and distance from private property. Pile or Rx can be used to remove fuel from private land as designated. Snags and down woody material may be retained in areas where fire resilience is not compromised. | Snags, slash, and down logs will be removed in proximity to private land. Pile burning or Rx can be used to remove fuel. Snags and down woody material may be retained in areas where fire resilience is not compromised. Vehicle pullouts should be planned in appropriate numbers and locations where vegetation, slope, and terrain permit. | After removal of heavy woody fuels, fine fuels may be maintained by cool-season low-intensity Rx that moves slowly downslope or into prevailing winds to midslope. Large down woody material and snags (≥12 inches) may be retained in riparian areas. | Fuel treatments and woody material removal will occur on existing roads. Cool-season low-intensity Rx may be used for maintenance of fine fuels. Pile or jackpot burning will not occur in ephemeral, intermittent, or perennial stream channels. | Response will be full suppression when firefighter and public safety, property, improvements, or natural resources are threatened. | Created slash will be made available for woody biomass use. If not used for wood-related products, slash will be piled with preexisting fuels and burned, or otherwise used for soil stabilization. Disturbed areas should be immediately revegetated with a native plant community that contains no invasive species and meets other land use objectives, such as wildlife habitat enhancements or recreational-use benefits. |

*Note:* BA = basal area, $R_x$ = prescribed fire, drc = diameter at root collar.

[a]List of Firewise plants can be found in the Firewise literature listed in Appendix C, Educational Resources.

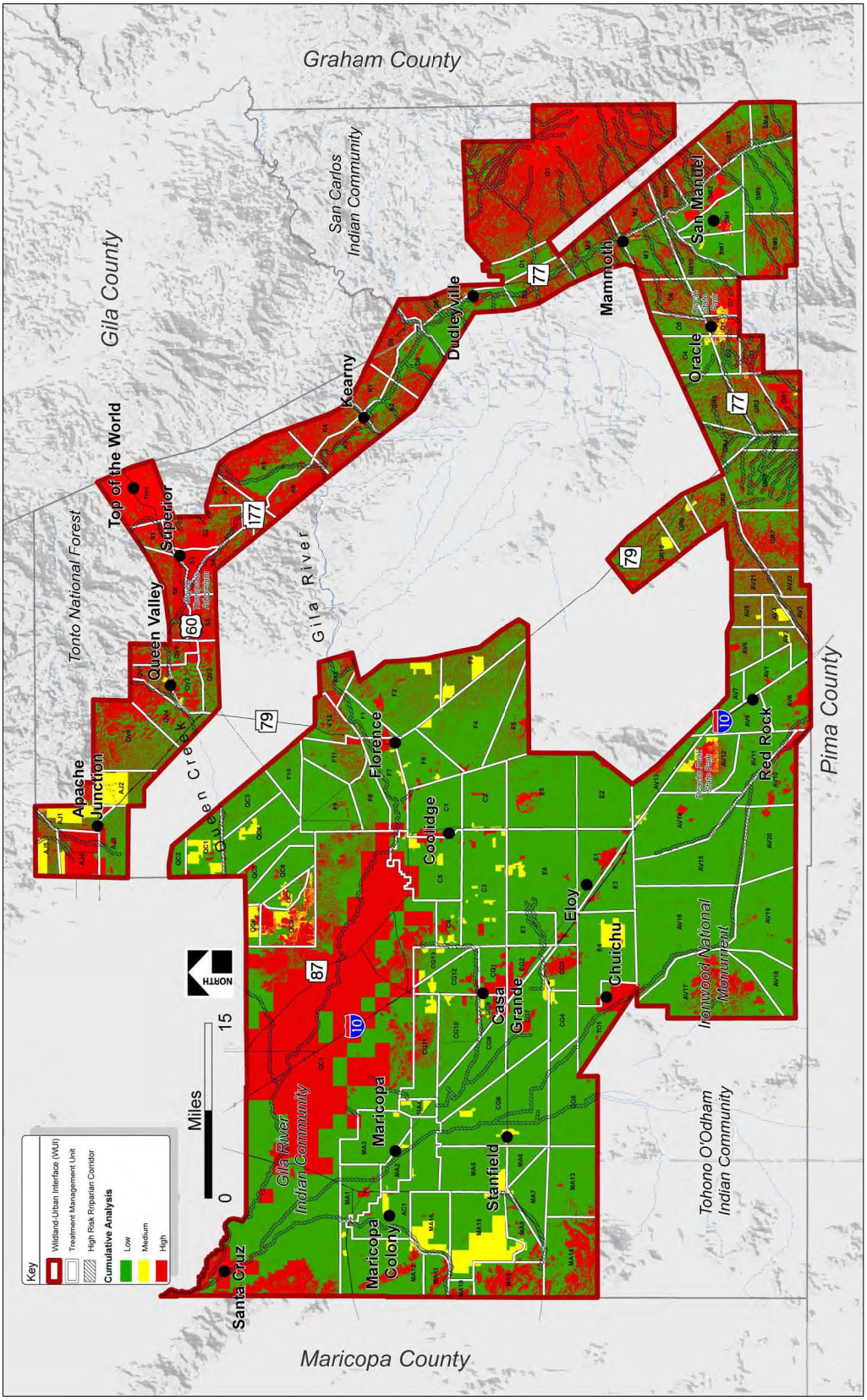



**Figure 3.1.** Pinal County CWPP treatment management units

The Core Teams described the location of each management unit in the WUI and then assigned recommended treatments for each unit (Table 3.2).The treatment management areas listed in Table 3.2 do not always coincide with fire-department or fire-district boundaries or lie within established fire departments and districts; for example, the Top of the World community and sub-WUI are not in any fire departments or districts or under FS jurisdiction for fire protection, and therefore, no fire departments or districts are responsible for that community's treatment management.

**Table 3.2.** Identified treatment management units

| Treatment management area | Map ID | Risk value | Location and description | Recommended treatment[a] | Total acres | Federal acres | State Trust acres[b] | Nonfederal acres[b] |
|---|---|---|---|---|---|---|---|---|
| **Apache Junction (AJ)** | AJ1 | M | Lands adjacent to Apache Junction to the north | 1,2,3,4 | 8,250 | 1,247 | 2,631 | 4,372 |
| | AJ2 | M | Lands adjacent to Apache Junction to the west to sub-WUI | 1,2,3,4 | 8,958 | 2 | 2,631 | 6,325 |
| | AJ3 | L | Lands adjacent to Apache Junction to the south to WUI boundary | 1,2,3,4,5,7,8 | 9,021 | 33 | 7,187 | 1,801 |
| | AJ4 | H | Lands adjacent to Apache Junction to the west | 1,2,3,4,8 | 8,536 | 71 | 730 | 7,735 |
| | AJ5 | H | Lands adjacent to Apache Junction to north to WUI boundary | 1,2,3,4,5,7,8 | 5,941 | 2,210 | 1,486 | 2,244 |
| **Queen Valley (QV)** | QV1 | H | Lands to north of Queen Valley | 1,2,3,4,6,7 | 4,541 | 301 | 2,473 | 1,767 |
| | QV2 | H | Lands south of Queen Valley, north of US 60 | 1,2,3,4,5,6,7,8 | 6,792 | 74 | 6,179 | 539 |
| | QV3 | H | South of US 60 to WUI boundary | 3,4,5,6 | 6,033 | 32 | 5,453 | 548 |
| | QV4 | H | Northwest of Queen Valley | 3,4,5,6,7,8 | 11,143 | 308 | 10,281 | 554 |
| | QV5 | H | Sub-WUI boundary to east, US 60 to south to WUI boundary | 3,4,5,6,7,8 | 6,401 | 6,361 | 40 | 0 |
| | QV6 | H | WUI boundary to north and south, sub-WUI boundary to west | 3,4,5,6,7,8 | 21,945 | 0 | 20,442 | 918 |
| **Superior (S)** | S1 | H | Superior to the north, north of US 60 to WUI boundary | 1,2,4,5,7 | 4,151 | 2,563 | 0 | 1,588 |
| | S2 | H | East of SR 177, south of US 60 | 1,2,3,4,5,6,7,8,9 | 11,909 | 10,778 | 87 | 1,043 |
| | S3 | H | Lands adjacent to Superior to the southwest, north of SR 177 | 1,2,4,6,7,9 | 3,205 | 2,166 | 0 | 1,039 |
| | S4 | H | West of SR 177 to WUI boundary and north to US 60 | 3,4,5,7,8,9 | 6,930 | 6,751 | 0 | 179 |
| | S5 | H | South of US 60 to sub-WUI boundary | 3,4,5,8 | 6,208 | 6,058 | 0 | 150 |

*Continued*

**Table 3.2.** Identified treatment management units

| Treatment management area | Map ID | Risk value | Location and description | Recommended treatment[a] | Total acres | Federal acres | State Trust acres[b] | Nonfederal acres[b] |
|---|---|---|---|---|---|---|---|---|
| | S6 | H | North of US 60 to WUI boundary | 1,2,4,6,7,9 | 9,935 | 7,863 | 0 | 2,072 |
| **Top of the World (TW)** | TW1 | H | Lands surrounding community of Top of the World | 1,2,4,5,6,7 | 14,251 | 13,028 | 1 | 1,221 |
| **Kearny (K)** | K1 | H | East of SR 177 to WUI boundary | 1,2,3,4,5,6,7,8,9 | 4,928 | 2,928 | 1,051 | 948 |
| | K2 | H | West of SR 177 to WUI boundary, includes Gila River | 1,2,3,4,5,6,7,8,9 | 7,260 | 3,717 | 1,263 | 2,280 |
| | K3 | H | West of SR 177 to WUI boundary, includes Gila River and community of Kearny | 1,2,3,4,5,6,7,8,9 | 8,718 | 2,399 | 545 | 5,775 |
| | K4 | H | East of SR 177 to WUI boundary | 1,2,3,4,5,6,7,8,9 | 7,750 | 4,743 | 0 | 3,007 |
| | K5 | L,H | East of SR 177 to WUI boundary | 1,2,3,4,5,6,7,8,9 | 18,799 | 2,436 | 4,998 | 11,365 |
| | K6 | H | West of SR 177 to WUI boundary | 1,2,3,4,5,6,7,8,9 | 7,453 | 4,604 | 1,150 | 1,699 |
| | K7 | H | Lands east and west of SR 177 to sub-WUI boundary | 1,2,3,4,5,6,7,8,9 | 7,170 | 2,593 | 4,184 | 393 |
| **Dudleyville (D)** | D1 | L | East of SR 77 to Galiuro Mtns. | 1,2,3,4,5,6,7,8,9 | 6,038 | 444 | 2,602 | 2,992 |
| | D2 | H | West of SR 77 to WUI boundary, includes San Pedro River | 1,2,3,4,5,6,7,8,9 | 9,526 | 287 | 5,325 | 3,914 |
| | D3 | L,M | West of SR 77 to WUI boundary, includes San Pedro River and Dudleyville | 1,2,3,4,5,6,7,8,9 | 11,589 | 2,289 | 3,368 | 5,933 |
| | D4 | H | East and south of SR 77 to WUI boundary | 1,2,3,4,5,6,7,8,9 | 6,528 | 3,073 | 2,833 | 622 |
| | D5 | H | East of SR 177 to WUI boundary | 1,2,3,4,5,6,7,8,9 | 7,044 | 3,493 | 139 | 3,413 |
| | D6 | L,H | West of SR 177 to WUI boundary, includes San Pedro River | 1,2,3,4,5,6,7,8,9 | 10,780 | 4,528 | 608 | 5,644 |
| **Galiuro Mountains (G)** | G1 | H | Portion of WUI encompassing Galiuro Mtns. | 1,2,4,5,6,8 | 95,205 | 25,986 | 40,661 | 28,558 |
| **Mammoth (M)** | M1 | | Community of Mammoth, north and west of SR 77 | 1,2,3,4,6,7,9 | 11,270 | 585 | 4,337 | 6,348 |
| | M2 | H | East of SR 77 to WUI boundary, includes San Pedro River | 1,2,3,4,6,7,9 | 7,574 | 25 | 4,677 | 2,872 |
| | M3 | L-H | San Pedro River north of community of Mammoth | 1,2,3,4,6,7,9 | 11,801 | 1,153 | 7,379 | 3,270 |

*Continued*

**Table 3.2.** Identified treatment management units

| Treatment management area | Map ID | Risk value | Location and description | Recommended treatment[a] | Total acres | Federal acres | State Trust acres[b] | Nonfederal acres[b] |
|---|---|---|---|---|---|---|---|---|
| **San Manuel (SM)** | SM1 | L,H | Lands surrounding community of San Manuel | 1,2,3,6,8 | 8,252 | 0 | 1,492 | 6,760 |
| | SM2 | H | East of community, west of San Pedro River | 1,2,3,6,7,8,9 | 9,041 | 1 | 806 | 8,235 |
| | SM3 | H | East of San Pedro River to WUI boundary | 1,2,3,6,7,8,9 | 10,092 | 212 | 8,279 | 1,601 |
| | SM4 | L,H | East of San Pedro River to WUI boundary | 1,2,3,6,7,8,9 | 8,302 | 0 | 7,112 | 1,190 |
| | SM5 | L | South of Campo Bonito Rd. to WUI boundary | 1,2,3,6,8 | 17,248 | 0 | 15,504 | 1,744 |
| | SM6 | L,H | South of Campo Bonito Rd. to WUI boundary, west and south | 1,2,3,6,8 | 15,114 | 9 | 10,069 | 5,036 |
| | SM7 | L | South of Smelter Wash to Campo Bonito Rd. | 1,2,3,6,8 | 7,636 | 0 | 5,410 | 2,226 |
| | SM8 | H | East of San Pedro River | 1,2,3,6,7,8,9 | 8,423 | 3,459 | 2,885 | 2,079 |
| | SM9 | H | East of San Pedro River | 1,2,3,6,7,8,9 | 5,134 | 0 | 3,685 | 1,449 |
| | SM10 | L,H | North of Smelter Wash, south of SR 77 | 3,5,6,8 | 7,119 | 0 | 5,775 | 1,344 |
| **Oracle (O)** | O1 | H | Lands surrounding Oracle, south of SR 77 | 1,2,4,6 | 3,109 | 465 | 0 | 2,644 |
| | O2 | H | Lands south of SR 77 | 1,2,4,6 | 4,126 | 0 | 2,743 | 1,383 |
| | O3 | H | South of Oracle, adjacent to CNF and WUI boundary | 1,2,4,5,6 | 4,024 | 6 | 1,935 | 2,083 |
| | O4 | L | North of SR 77, south of WUI boundary | 1,2,4,5,6 | 8,779 | 0 | 7,628 | 1,150 |
| | O5 | L,H | West of Tucson Wash, north of Oracle to WUI boundary | 1,2,4,5,6 | 4,976 | 0 | 2,844 | 2,132 |
| | O6 | H | East of Tucson Wash, north of SR 77, south of WUI boundary | 1,2,4,5,6 | 8,478 | 30 | 5,053 | 3,395 |
| | O7 | H | East of Oracle, south of SR 77, includes Oracle State Park | 1,2,4,5,6 | 7,901 | 837 | 921 | 6,143 |
| **Golder Ranch (GR)** | GR1 | H | Community of Golder Ranch | 1,2,3,4,6,7,9 | 8,291 | 4 | 3,482 | 4,806 |
| | GR2 | L-H | North of Golder Ranch, south of SR 77 | 1,2,3,5,4,8 | 9,330 | 0 | 8,076 | 1,254 |
| | GR3 | L | Lands immediately west of SR 77, includes Oracle Junction | 3,4,5,8 | 3,751 | 0 | 3,751 | 0 |
| | GR4 | L,H | North and east of SR 79, west of Big Wash | 1,2,3,5,4,8 | 5,737 | 0 | 4,196 | 1,540 |
| | GR5 | H | North of SR 77, east of Big Wash | 1,2,3,5,4,8 | 12,301 | 0 | 8,721 | 3,580 |

*Continued*

**Table 3.2.** Identified treatment management units

| Treatment management area | Map ID | Risk value | Location and description | Recommended treatment[a] | Total acres | Federal acres | State Trust acres[b] | Nonfederal acres[b] |
|---|---|---|---|---|---|---|---|---|
| | GR6 | L,M | Drainages from Tortolita Mtns., southwest of SR 79 | 3,4,5,8 | 20,159 | 0 | 19,783 | 377 |
| | GR7 | L,H | Tortolita Mtns. foothills to north, WUI boundary to south | 1,2,3,4,6 | 14,753 | 1,616 | 5,314 | 7,823 |
| | GR8 | H | North of Guild Wash, south of Chief Butte, west of SR 79 | 3,4,5,8 | 13,979 | 0 | 11,179 | 2,801 |
| | GR9 | H | Lands on either side of SR 79 from Park Link Rd. to Chief Butte | 3,4,5,8 | 7,273 | 0 | 5,502 | 1,771 |
| | GR10 | H | Lands surrounding SR 79 from Park Link Rd. to WUI boundary | 3,4,5,8 | 13,505 | 550 | 8,548 | 4,407 |
| **Avra Valley (AV)** | AV1 | L | East of I-10 and east of Red Rock to CAP canal | 1,2,3,5,8 | 6,618 | 0 | 4,909 | 1,709 |
| | AV2 | L,M,H | North of Guild Wash, east of I-10 | 1,2,3,8 | 6,010 | 882 | 2,725 | 2,403 |
| | AV3 | H | South of Guild Wash to WUI boundary | 1,2,3,8 | 4,028 | 1,198 | 1,598 | 1,232 |
| | AV4 | H | North of Guild Wash | 1,2,3,8 | 3,491 | 806 | 919 | 1,766 |
| | AV5 | H | South of WUI boundary | 1,2,3,8 | 4,579 | 1,197 | 967 | 2,415 |
| | AV6 | L,H | South of WUI boundary, east of CAP canal | 1,2,3,5,8 | 6,780 | 747 | 2,862 | 3,170 |
| | AV7 | L | North of I-10, west of CAP canal to WUI boundary | 1,2,3,5,8 | 4,829 | 0 | 4,168 | 661 |
| | AV8 | L,H | West of I-10, south of Sasco Rd., includes Pinal Airpark and small portion of Santa Cruz River | 1,2,3,5,7,8,9 | 12,170 | 0 | 8,592 | 3,577 |
| | AV9 | L | Community of Red Rock, west of I-10, north of Sasco Rd. | 1,2,3,5,8 | 7,300 | 0 | 5,817 | 1,483 |
| | AV10 | L, H | Santa Cruz River to north, south to WUI boundary, includes small portion of Ironwood National Forest | 1,2,3, 7,8,9 | 11,993 | 610 | 4,357 | 7,025 |
| | AV11 | L | South of Picacho Peak State Park to the Santa Cruz River | 1,2,3, 7,8,9 | 10,322 | 0 | 6,074 | 4,248 |
| | AV12 | L,M,H | Lands surrounding Picacho Peak State Park, south of I-10 | 1,2,3,6,8 | 13,964 | 0 | 8,891 | 5,073 |
| | AV13 | L | Lands north of I-10, north of Picacho Peak State Park to WUI boundary, south of Phillips Rd. | 1,2,3,5,8 | 8,655 | 0 | 6,332 | 2,323 |
| | AV14 | L | East of Santa Cruz River, west of I-10 and Picacho Peak State Park | 1,2,3, 5,7,8,9 | 21,919 | 329 | 11,279 | 10,312 |
| | AV15 | L | North of Greene Canal, west of Santa Cruz River, south of Phillips Rd.. | 1,2,3, 5,7,8,9 | 24,055 | 0 | 5,899 | 18,156 |

*Continued*

**Table 3.2.** Identified treatment management units

| Treatment management area | Map ID | Risk value | Location and description | Recommended treatment[a] | Total acres | Federal acres | State Trust acres[b] | Nonfederal acres[b] |
|---|---|---|---|---|---|---|---|---|
| | AV16 | L | North of Greene Canal, east of Greene Wash, south of Phillips Rd. | 1,2,3, 5,7,8,9 | 37,069 | 96 | 12,347 | 24,627 |
| | AV17 | L, H | Sawtooth Mtns. and Ironwood National Forest; Greene Wash to north and east, WUI boundary to west | 3,5,8 | 30,460 | 15,109 | 12,841 | 2,510 |
| | AV18 | L | Southeast of Sawtooth Mtns., to WUI boundary on south, | 1,2,3,5,8 | 9,945 | 648 | 4,486 | 4,812 |
| | AV19 | L | South of Greene Canal to southern WUI boundary | 1,2,3,5,8 | 22,939 | 1,277 | 13,865 | 7,797 |
| | AV20 | L | South of Greene Canal, north of WUI boundary | 1,2,3,5,8 | 16,726 | 884 | 10,971 | 4,870 |
| | AV21 | H | North of Guild Wash, south of WUI boundary | 1,2,3,8 | 5,152 | 299 | 4,095 | 758 |
| | AV22 | H | South of Guild Wash, north of WUI boundary at foothills of Tortolita Mtns. | 1,2,3,8 | 3,882 | 118 | 2,471 | 1,292 |
| **Eloy (E)** | E1 | L, H | Includes the lands surrounding Eloy and Picacho, northeast of I-10, west of SR 87 | 1,2,3,8 | 11,343 | 0 | 424 | 10,920 |
| | E2 | L | East of SR 87 to WUI boundary, north of Phillips Rd. and south of Battaglia Rd. | 1,2,3,5,8 | 16,844 | 6 | 9,688 | 7,150 |
| | E3 | L | Southwest of I-10 to Phillips Rd. | 1,2,3,8 | 10,634 | 0 | 0 | 10,634 |
| | E4 | L,M | North of Phillips Rd., south of Battaglia Rd., east of Chuichu | 1,2,3,8 | 21,753 | 88 | 3,023 | 18,642 |
| | E5 | L | East of SR 87, south of SR 84, north of Battaglia Rd. to WUI boundary | 1,2,3,5,8 | 24,549 | 420 | 13,116 | 11,013 |
| | E6 | L | West of SR 87, north of Battaglia Rd. and south SR 84, includes community of Toltec | 1,2,3,7,8,9 | 30,857 | 0 | 1,270 | 29,587 |
| | E7 | L | Lands surrounding Casa Grande Canal, east of I-10, south of SR 84 | 1,2,3,7,8,9 | 7,508 | 0 | 0 | 7,508 |
| **Florence (F)** | F1 | L | North and west of Florence, includes Gila River | 1,2,3,6,7,8,9 | 5,913 | 446 | 470 | 4,997 |
| | F2 | L,H | East of SR 79, south and east of Florence to WUI boundary | 1,2,3,5,6,8 | 22,693 | 2,030 | 12,318 | 8,344 |
| | F3 | L,M,H | East of SR 79 to WUI boundary on east and south | 1,2,3,5,6,8 | 13,260 | 490 | 8,500 | 4,269 |
| | F4 | L | West of SR 79 to power-line easement | 1,2,3,5,6,8 | 28,727 | 0 | 21,623 | 7,104 |

*Continued*

**Table 3.2.** Identified treatment management units

| Treatment management area | Map ID | Risk value | Location and description | Recommended treatment[a] | Total acres | Federal acres | State Trust acres[b] | Nonfederal acres[b] |
|---|---|---|---|---|---|---|---|---|
| | F5 | L | North of WUI boundary, south of power-line easement | 3,5,6,8 | 10,948 | 119 | 10,789 | 31 |
| | F6 | L | South and west of Florence, west of SR 79 | 1,2,3,5,6,8 | 10,852 | 0 | 4,219 | 6,633 |
| | F7 | L | Florence to the northwest, includes Gila River | 1,2,3,6,7,8,9 | 9,942 | 130 | 367 | 9,445 |
| | F8 | L,H | North of Gila River, east of GRIC | 1,2,3,5,6,8 | 7,336 | 12 | 1,096 | 6,228 |
| | F9 | L | East of GRIC, includes portions of SR 87 and UPRR | 1,2,3,5,6,8 | 14,451 | 978 | 2,963 | 10,510 |
| | F10 | L | Southeast of MARR, WUI boundary on east | 1,2,3,5,6,8 | 6,194 | 0 | 3,072 | 3,122 |
| | F11 | L,H | Lands west of Florence Military Reservation to UPRR | 1,2,3,5,6,8 | 8,844 | 1,042 | 2,247 | 5,555 |
| | F12 | H | Florence Military Reservation | 1,2,3,5,6,8 | 6,718 | 6,033 | 615 | 69 |
| | F13 | H | Gila River, east of Florence Military Reservation | 1,2,3,5,6,7,8,9 | 5,115 | 675 | 1,919 | 2,521 |
| **Coolidge (C)** | C1 | L | Lands surrounding Coolidge, east of SR 87, south of SR 287 | 1,2,3,5,8 | 13,897 | 41 | 578 | 13,278 |
| | C2 | L | South of Coolidge, north of SR 84, east of SR 87 | 1,2,3,5,8 | 13,171 | 2 | 3,846 | 9,323 |
| | C3 | L | South of Coolidge, north of SR 84, west of SR 87 | 1,2,3,5,8 | 24,893 | 0 | 796 | 24,097 |
| | C4 | L,H | South of GRIC, includes Black Butte and Signal Peak | 1,2,3,5,8 | 5,368 | 0 | 38 | 5,330 |
| | C5 | L | West of Coolidge, south of GRIC | 1,2,3,5,8 | 18,468 | 476 | 761 | 17,532 |
| **Queen Creek (QC)** | QC1 | L,M | North of Queen Creek, WUI boundary to east and west | 1,2,3,5,8 | 9,906 | 480 | 2,561 | 6,865 |
| | QC2 | L | North of Queen Creek, WUI boundary to north, east, and west | 3,8 | 3,477 | 0 | 2,554 | 922 |
| | QC3 | L | South of Queen Creek north of MARR, WUI boundary to east | 3,5,8 | 8,912 | 0 | 5,916 | 2,997 |
| | QC4 | L | North of MARR, south of Queen Creek, east of UPRR | 1,2,3,5,8 | 17,130 | 0 | 3,643 | 13,487 |
| | QC5 | L | West of UPRR to Hunt Highway | 1,2,3,5,8 | 6,239 | 0 | 2,967 | 3,279 |
| | QC6 | L | West of Hunt Highway | 1,2,3,5,8 | 9,077 | 0 | 2,012 | 7,065 |
| | QC7 | L,M,H | Borders San Tan Park east to QC8 | 1,2,3,5,8 | 4,519 | 0 | 569 | 3,950 |
| | QC8 | M | Lands north of San Tan Park, south of WUI boundary | 1,2,3,8 | 2,784 | 0 | 0 | 2,783 |

*Continued*

**Table 3.2.** Identified treatment management units

| Treatment management area | Map ID | Risk value | Location and description | Recommended treatment[a] | Total acres | Federal acres | State Trust acres[b] | Nonfederal acres[b] |
|---|---|---|---|---|---|---|---|---|
| | QC9 | H | Lands surrounding San Tan Park, north of GRIC | 1,2,3,5,8 | 15,579 | 7 | 126 | 15,446 |
| **Tohono O'odham Nation (TO)** | TO1 | L,H | Tribal community of Chuichu to WUI boundary | 1,2,3,5,6,7,8,9 | 11,159 | 11,096 | 63 | 0 |
| **Gila River Indian Community (GC)** | GC1 | L, H | Tribal lands to WUI boundary, community of Santa Cruz, portions of Santa Cruz Wash and Gila River | 1,2,3,5,6,7,8,9 | 279,807 | 277,944 | 1,158 | 704 |
| **Ak-Chin Indian Community (AC)** | AC1 | L | Tribal lands surrounding Maricopa Colony | 1,2,3,5,6,7,8,9 | 21,130 | 20,978 | 0 | 152 |
| **Maricopa (MA)** | MA1 | L,H | Lands between ACIC to south and GRIC to north | 1,2,3,7,8,9 | 9,388 | 653 | 5,137 | 14,868 |
| | MA2 | L | Lands surrounding Maricopa to south and west | 1,2,3,7,8,9 | 5,146 | 31 | 4,738 | 7,817 |
| | MA3 | L | Lands surrounding Maricopa to north to GRIC boundary | 1,2,3,8 | 13,356 | 1,156 | 7,416 | 16,585 |
| | MA4 | L,M | East of ACIC, south of GRIC | 1,2,3,8 | 2,968 | 9 | 354 | 2,605 |
| | MA5 | L | West of Stanfield Rd., north of SR 84 | 1,2,3,8 | 14,527 | 1 | 610 | 13,915 |
| | MA6 | L | West of Stanfield Rd., south of SR 84 | 1,2,3,8 | 3,995 | 0 | 1,210 | 2,784 |
| | MA7 | L | South and east of SR 84, north of I-8 | 1,2,3,7,8,9 | 9,861 | 3,699 | 1,473 | 4,689 |
| | MA8 | L,H | Northwest of SR 84 to Wilderness boundary | 1,2,3,8 | 6,534 | 620 | 3,361 | 2,553 |
| | MA9 | H | Table Top Wilderness, north of I-8 | 1,2,3,5,8 | 11,594 | 10,530 | 704 | 360 |
| | MA10 | M | South of Vekol Wash | 1,2,3,5,8 | 1,991 | 1,768 | 0 | 224 |
| | MA11 | L,H | North and west of Vekol Wash to WUI boundary | 1,2,3,7,8,9 | 5,068 | 2,542 | 0 | 2,526 |
| | MA12 | L,H | South of GRIC, west of ACIC to WUI boundary | 1,2,3,5,8 | 22,837 | 6,340 | 2,502 | 13,994 |
| | MA13 | L | I-8 south to WUI boundary | 1,2,3,5,8 | 16,697 | 13,076 | 722 | 2,898 |
| | MA14 | L,H | T able Top Wilderness, south of I-8 to WUI boundary | 1,2,3,5,8 | 20,080 | 19,912 | 41 | 127 |

*Continued*

**Table 3.2.** Identified treatment management units

| Treatment management area | Map ID | Risk value | Location and description | Recommended treatment[a] | Total acres | Federal acres | State Trust acres[b] | Nonfederal acres[b] |
|---|---|---|---|---|---|---|---|---|
| | MA15 | L, M | West of SR 347, east of wilderness boundary | 1,2,3,5,8 | 21,694 | 415 | 1,535 | 19,744 |
| | MA16 | L,M | South and east of Vekol Wash, south of ACIC | 1,2,3,5,8 | 11,358 | 37 | 1,592 | 9,729 |
| **Casa Grande (CG)** | CG1 | L,H | Lands surrounding Casa Grande to southeast | 1,2,3,8 | 6,448 | 0 | 488 | 5,960 |
| | CG2 | L,H | North of Jimmy Kerr Blvd., south of SR 84, west of I-10 | 1,2,3,7,8,9 | 6,086 | 0 | 0 | 6,086 |
| | CG3 | L,H | Lands surrounding Casa Grande Mtns., west of I-10, south of I-8 | 1,2,3,8 | 6,518 | 798 | 641 | 5,079 |
| | CG4 | L | South of I-8, east of Greene Wash | 1,2,3,8 | 8,058 | 0 | 763 | 7,294 |
| | CG5 | L | I-8, south to WUI boundary | 1,2,3,5,7,8,9 | 19,794 | 2,041 | 2,480 | 15,273 |
| | CG6 | L | Community of Stanfield and portions of Santa Rosa Wash and Green Wash | 1,2,3,5,7,8,9 | 33,090 | 193 | 3,965 | 28,932 |
| | CG7 | L,H | North of I-8, south of SR 84, west of Jimmy Kerr Blvd. | 1,2,3,7,8,9 | 15,133 | 0 | 0 | 15,133 |
| | CG8 | L,M | North of SR 84, west of Jimmy Kerr Blvd. | 1,2,3,7,8,9 | 16,544 | 0 | 1,230 | 15,325 |
| | CG9 | H | Lands surrounding Casa Grande to southwest | 1,2,3,8 | 3,498 | 0 | 16 | 3,483 |
| | CG10 | L,M | West of SR 387, northeast of Jimmy Kerr Blvd. | 1,2,3,7,8,9 | 13,144 | 0 | 1,438 | 11,706 |
| | CG11 | L,M,H | South of GRIC, west of SR 387 | 1,2,3,8 | 12,885 | 354 | 1,273 | 11,258 |
| | CG12 | L | East of SR 387, west of I-10 | 1,2,3,7,8,9 | 8,836 | 0 | 1,068 | 7,768 |
| | CG13 | L,M | Northeast of I-10 to GRIC boundary | 1,2,3,8 | 5,641 | 161 | 2,587 | 2,894 |

*Note*: L = low, M = moderate, H = high, GRIC = Gila River Indian Community, UPRR = Union Pacific Railroad, MARR = Magma Arizona Railroad, ACIC = Ak-Chin Indian Community.

[a]See Table 3.1 for recommended treatments.

[b]"—" indicates no State Trust or nonfederal acres within the treatment management area.

Private land treatments in the WUI typically occur on small land parcels near power lines, structures, and other obstacles. In many cases, cut trees and slash cannot be piled and burned on small private land parcels, or it is not the preferred slash treatment by the owner of a small residential lot or by the local fire departments. Therefore, the Core Teams recommend that slash from wildland fuel reduction treatments on small residential parcels be removed, whole or chipped, and transported to a disposal site. The Core Teams do not oppose alternate vegetative treatments to achieve wildland vegetative fuel mitigation objectives, such as an experimental grazing program using primary grazers within the WUI, adjacent to state or federal lands. The Core Teams also recommend that fallow agricultural lands be restored through the planting of native vegetation species in accordance with the *National Conservation Practice Standards,*

*Range Planting*, Code 550 (NRCS 2002). The Core Teams also recommend that firebreaks constructed on public and private lands to restrict wildland fire movement be maintained in accordance with the above-mentioned mitigation measures and stipulations on a rotating 2- or 3-year interval, or as deemed necessary, to ensure the integrity of the firebreak through removal of fine and light vegetative fuels.

Treatment of wildland fuels within the WUI is expected to generate considerable slash and vegetative waste material. Private individual use of wood products from fuel reduction treatments within the WUI is primarily for fuelwood. Commercial use of the woody material from fuel reduction treatments is also primarily limited to fuelwood, and any commercial value of treatment by-products will not significantly affect land treatment costs. If wildland fuel modification prescriptions require follow-up pile burning or herbicide application after vegetation treatment, the total cost per acre treated could be as high as $5,000.00/acre on small land parcels consisting mostly of treatments within a riparian corridor and as high as $3,500.00 per acre for small acreage treatments in heavy chaparral/timber (USDA and New Mexico Energy, Minerals and Natural Resources Department, Forestry Division 2005).

For private land treatments to be both fiscally reasonable and timely, the Core Teams investigated land treatment costs from a variety of sources. Equivalent land treatment costs are not directly available for the Pinal County CWPP WUI. Costs estimates within northern Arizona average $12,000.00/acre on timbered private parcels and slightly less than $600.00/acre for forested landscape treatments that produce a fire-resilient stand appropriate for the habitat (Lloyd Wilmes, Sitgreaves Community Wildfire Protection Plan coordinator, personal communication). Within nontimbered vegetative stands of the Pinal County CWPP WUI, the estimates for land treatment costs vary by vegetation type, geography, and distance from communities. Within nontimbered stands of the Pinal County CWPP WUI, estimates for land treatments costs are based on per acre estimates for thinning by hand, roller chopping, mastication, and other mechanical vegetative fuel treatments, including broadcast burning at $150.00–$200.00 per acre for desert grasslands and $350.00–$500.00 per acre for oak woodlands.

The Core Teams recommend that when available, wildland fuel modification projects be contracted to ASFD to ensure that treatments are conducted in a timely fashion and at a reasonable cost. The estimates of daily costs, which include a 20-person inmate labor crew and a chipper for a 100-mile roundtrip to the project site by an ASLD Forestry Division crew carrier, are as follows:

- 8-hour day—$750.00
- 10-hour day—$830.00
- 12-hour day—$910.00

Cost estimates for treatments in the WUI are based on the estimates provided by the ASLD Forestry Division for the Fire and Fuels Crew costs for both Federal and non-Federal land treatments (see Table 3.3). The ASLD Forestry Division Fire and Fuels Crews do not remove hazard trees or provide “climbers” for pruning or segmented tree removal sometimes required on private lands. The Core Teams do support and encourage local business development that will complement wildland fuel mitigation needs within federal and nonfederal lands of the WUI.

**Table 3.3.** Acres of wildland fuels mitigation treatment conducted by ASFD Fire and Fuels Crew during an 8-hour on-site workday

| Vegetation association | Average acres per day treated |
|---|---|
| Ponderosa pine/mixed conifer | 0.5 to 1 acre per day |
| Pinyon/juniper | 1 to 2 acres per day |
| Mesquite woodland | 3 to 4 acres per day |
| Oak woodland | 3 to 4 acres per day |
| Riparian | 1 to 2 acres per day (depending on fuel loading) |
| Grassland | 2 to 4 acres per day (depending on grass type and fuel loading) |

The Core Teams recommend that private landowners who wish to adopt fuel modification plans other than those described in Table 3.1 should have the plan prepared or certified by a professional forester, a certified arborist, or other qualified individuals. Fuel modification plans for federal and state lands within 0.5 mile of private land may be prepared for wildlife and watershed benefits—including the retention of large snags or vegetative patches of high wildlife value—in areas more than 600 ft from private lands in which fire resiliency is not impaired and will not compromise public or firefighter safety. A fuel modification plan should identify the actions necessary to promote rangeland, wildlife, or watershed health and to help prevent the spread of fire to adjacent properties by establishing and maintaining defensible space. The action identified by the fuel modification plan should be completed before development of the property or identified during project initiation on federal and state lands.

### Alternate Federal, State, or Private Land Wildland Fuel Modification Plan

A fuel modification plan for federal and state lands will follow agency procedures, standards, and guidelines. Fuel modification treatment plans for private land parcels should at least include the following information:

- A copy of the site plan
- Methods and timetables for controlling, changing, or modifying fuels on the properties in a timely and effective manner
- Elements for removal of slash, snags, and vegetation that may grow into overhead electrical lines; removal of other ground fuels, ladder fuels, and diseased, dying, and dead trees; and thinning of live trees
- Methods and timetables for controlling and eliminating diseased or insect-infested vegetation
- A plan for the ongoing maintenance of the proposed fuel reduction and control measures for disease and insect infestations
- A proposed vegetation management plan for groupings of parcels under multiple ownership that has been accepted by all individual owners (subject to compliance with this section)

HFRA was designed to expedite administrative procedures for conducting hazardous wildland fuel reduction and restoration projects on federal lands. Regardless of priority treatments selected for federal lands, an environmental assessment must be conducted for fuel reduction projects. Although HFRA creates a streamlined and improved process for reviewing fuel reduction and restoration treatments, it still requires that appropriate environmental assessments be conducted and that collaboration be maintained. To meet conditions established by the Healthy Forests Initiative, the USDA and the USDI adopted two new categorical exclusions from the normal review steps of an environmental assessment or an environmental impact statement. These exclusions are for hazardous fuels reductions and for rehabilitation of resources and infrastructure damaged by wildfire. For a hazardous fuels reduction project on public lands to be categorically excluded from documentation of the results of an environmental assessment, the project must meet specific requirements:

- It must have less than 4,500 acres to be treated, with mechanical slash treatment restricted to no more than 1,000 acres.
- Its lands must be within Condition Class 2 or 3 and not be in a wilderness or wilderness study area.
- It must not include the use of pesticides, herbicides, or new road or infrastructure construction.
- It may include sale of vegetative products if the primary purpose is to reduce hazardous fuels.

The recommended treatments within the Pinal County CWPP have been developed consistent with federal land-management action alternatives and are intended to be compliant with Categorical Exclusion 10, Fuel Reduction. The purpose of Categorical Exclusion 10, Fuel Reduction, is “to facilitate efficient planning and decision making concerning rehab of areas so as to reduce risks to communities caused by severe fires, and to restore fire-adapted ecosystems” (USDA FS 2000).

### B. Prevention and Loss Mitigation

The Pinal County CWPP will be used as a resource to help coordinate long-term interagency mitigation of catastrophic wildfire events in at-risk communities within Pinal County. The Pinal County CWPP goals are as follows:

- Improve fire prevention and suppression for firefighter and public safety and to protect private property
- Promote community involvement and education
- Recommend measures to reduce structural ignitability in the Pinal County CWPP WUI
- Preserve the aesthetics and wildlife values within riparian areas
- Identify funding needs and opportunities
- Expedite project planning through partnerships with ASFD, BLM, and other private and public entities in managing wildland fire risk within the WUI

The Pinal County CWPP should be reviewed and updated as needed. Successful implementation of this plan will require a collaborative process among multiple layers of government entities as well as a broad range of community interests. The PCOEM and Core Teams have also discussed the advantage of

working cooperatively with Salt River Project (SRP) and Arizona Public Service (APS) utility companies in maintaining acceptable wildland fuel conditions within SRP and APS existing utility corridor rights-of-ways and easements, within areas of the WUI at high risk. The Core Teams, APS and SRP also recognize the benefits of working cooperatively to achieve acceptable wildland fuel conditions adjacent to APS and SRP easements and rights-of-ways. The Core Teams recognize existing agreements between SRP, APS, land management agencies, and private landowners for vegetative treatments within rights-of-ways and easements, and agree the Pinal County CWPP does not bind or obligate SRP and APS in maintenance of vegetative fuels outside their rights-of-ways or easements. The Core Teams believe these agreements and resultant vegetative treatments are complimentary to the objectives of the Pinal County CWPP. Therefore, at the request of PCOEM and Core Teams, APS and SRP have agreed to be included as signatories to the Pinal County CWPP and to become partners in implementation of action recommendations.

The Core Teams and collaborators have made the following action recommendations to meet the goals of the Pinal County CWPP:

1. Pinal County CWPP Administration and Implementation

Establish a countywide community Pinal County CWPP Working Group, composed of the Fire Chief Association of Pinal County, PCOEM, ASFD, BLM, CNF, TNF, Pinal County Planning and Zoning, community members, concurring agencies, and members of the Core Teams, to coordinate individual agency implementation of the recommendations for fuel modification, public outreach, protection capability, and structural ignitability within the Pinal County CWPP WUI, including fuel hazards removal on private lands within the WUI.

2. Improved Protection Capability and Reduction in Structural Ignitability

The Pinal County CWPP considers the risks of wildland fire igniting and spreading throughout the WUI a serious threat. The Core Teams and collaborators believe that actions to reduce fire risks and promote effective responses to wildland fires must be undertaken. The following are recommendations to enhance protection capabilities for at-risk communities within Pinal County:

- Obtain one fully functional type 6 engine and one fully functional type 1 engine for wildland fire response by local fire departments and districts.
- Obtain a medium-size water tender for local FD use; strategically locate additional water-storage tanks, wells, or other water sources for tender filling throughout the fire departments and districts; maintain helicopter landing sites; and update mapping capabilities of local fire departments and districts.
- Improve dispatch and alerting capabilities by establishing a community emergency alert system. The County and local communities will continue to jointly investigate an emergency contact autophone redial system for emergency public communication.
- Obtain a chipper/shredder, tub grinder, air curtain destructor, and other equipment necessary for treatment and processing of vegetative slash for use by local fire departments and districts for wildland fuel mitigation projects.

- Obtain one multipurpose utility vehicle with attachments for chipping, brush cutting, and miniwater tending tool, such as the Bobcat Toolcat.
- Implement GIS and GPS (Global Positioning System) software and laptops to update mapping capabilities of local fire departments and districts.
- Arrange for the acquisition, operation, and maintenance of a green-waste disposal site within reasonable proximity to the citizens and encourage the use of the disposal site for all vegetative material removed during wildland fuel treatments on private lands within the WUI.
- Provide enhanced and coordinated firefighting training and equipment, such as personal protective equipment (PPE) and second-generation fire shelters, for newly certified wildland firefighters and volunteer firefighters.
- Develop and maintain mutual-aid agreements with neighboring fire departments or districts for wildland and structural fire response support and other emergency response.
- Meet annually with representatives from APS and SRP to mutually identify locations of needed vegetative treatments within rights-of-ways in high risk areas of the WUI and support the Core Team in obtaining grants and agreements necessary to implement vegetative fuel reduction projects adjacent to rights-of-ways.
- Develop a presuppression plan with BLM and FS along the boundary of the WUI.
- Develop additional wildland fire preplans for all high-hazard locations across Pinal County where they have not been adopted.
- Develop IGAs with Pinal County on nuisance-abatement projects located in high-hazard communities.
- Meet annually, immediately before the fire season, to coordinate early suppression deployment and to determine training and equipment needs.

3. Promote Community Involvement and Improved Public Education, Information, and Outreach

Pinal County, BLM, CNF, TNF, ASFD, local fire departments and districts, and the Core Teams will continue developing and implementing public outreach programs to help create an informed citizenry. The goal is to have residents support concepts of Firewise landscaping and naturally functioning wildland systems through restoration management and rapid response to wildland fire. The Pinal County CWPP is intended to be a long-term strategic instrument containing prescriptive recommendations to address hazardous fuels. A grassroots collaborative structure of individual citizens, supported by local governments as full partners, will provide the most effective long-term means to achieve these goals and to maintain community momentum. Additional educational resources are listed in Appendix C. The components of such a structure include the following recommendations:

- Assist in implementing a Firewise Communities/USA Recognition program in communities where the program is supported by the local fire departments and districts. The Firewise Communities approach emphasizes community and individual responsibility for safer home construction and design, landscaping, and maintenance. The Core Teams will also help identify high-priority communities that would most benefit from a Firewise Communities program.

- Expand the use of current public information tools for fire-safe residential treatments as an immediate action step. This will be accomplished through information mailers to homeowners, presentations by local fire departments and districts, the use of the Arizona Firewise Partners Public Information Trailer (BLM Tucson Field Office) at community events, and the development of specific promotional materials by Pinal County.
- Place fire-danger information signs on major access roads throughout the WUI. Community bulletins and other public service announcements concerning wildfire threat and preparedness should be developed with assistance from ASFD, BLM, and Pinal County.
- Place and maintain bilingual wildfire caution signs within camping areas and access routes in some areas of the WUI.
- Complete wildfire home assessments through the use of Redzone software, or an equivalent software system, and submit wildfire hazard mitigation strategies to landowners for each private property assessed.
- Replace and maintain fencing adjacent to high-use and illegal off-road-vehicle use areas within or adjacent to the WUI.

4. Encourage Use of Woody Material from WUI Fuel Mitigation Programs

The Core Teams and their collaborators will continue to support and promote private contractors who perform Firewise mitigation work. The County will continue to support and promote new businesses involved in the wildland fuel reduction market. Pinal County, CNF, TNF, BLM, and local fire departments and districts are committed to encouraging, as appropriate, the use of vegetative by-products from the WUI fuel management program for commercial or community-service organization use. Possible by-product uses encouraged by the Core Teams include the following:

- Bagged mesquite wood for sale to visitor and larger-community markets as “campfire cooking” for commercial or personal culinary uses
- Firewood marketed to local residents, visitors, and adjacent communities
- Mesquite, pinyon pine, and juniper wood marketed for artwork, furniture, and other specialty wood products

# IV. PINAL COUNTY CWPP PRIORITIES: ACTION RECOMMENDATIONS AND IMPLEMENTATION

The Core Teams have developed action recommendations (see Section III of this CWPP) necessary to meet the plan's objectives. A series of recommendations that will reduce structural ignitability, improve fire prevention and suppression, and enhance public outreach have also been developed by the Core Teams. A unified effort to implement this collaborative plan requires timely decision making at all levels of government.

To meet Pinal County CWPP objectives, the Core Teams have developed the following action recommendations. At the end of each year, projects implemented from these action recommendations will be monitored for effectiveness of meeting Pinal County CWPP objectives. For the life of the Pinal County CWPP, recommendations for additional projects will be made for each future year on the basis of project performance from the previous implemented projects.

## A. Administrative Oversight

Generally, the most efficient way to manage the mitigation of wildland fire threat in the WUI is through identifying, delegating, implementing, and monitoring the action recommendations of the Pinal County CWPP. Establishing a unified effort to collaboratively implement the Pinal County CWPP embraces adaptive management principles that enhance decision making and reduce inconsistency at all levels of government.

The Core Teams recommend the establishment of a countywide community Pinal County CWPP Working Group, composed of the Fire Chief Association of Pinal County, ASFD, PCOEM, CNF, TNF, and BLM, to work with the Core Teams and concurring agencies to accomplish the recommendations for outreach and structural ignitability within the Pinal County CWPP WUI area, which includes fuel hazards removal on private lands within the WUI. The Pinal County CWPP Working Group should consist of community members; local fire departments and districts; and, as needed, additional representatives from the PCOEM, ASFD, ASLD, BLM, and other concurring agencies.

The charter of the Pinal County CWPP Working Group will be as follows:

1. Prioritize wildland fuel modification, structural ignitability, protection capability, and public outreach projects listed in the approved Pinal County CWPP on a countywide basis, in accordance with the criteria detailed below, and review for possible reprioritization at least once annually, starting within 2 months of final Pinal County CWPP approval by ASFD.

   *Note*: Fuel modification and community planning, outreach, and warning programs will be prioritized by the Pinal County CWPP Working Group as a whole; other projects involving firefighter training, equipment, communications, facilities, and apparatus will be recommended by the Pinal County Fire Officers Association or its representatives in the Pinal County CWPP Working Group.

2. Support fire departments and districts or other agencies in the submittal of grant applications and the solicitation of other funding opportunities to implement wildland fuel modification, structural ignitability, protection capability, and public outreach projects established as priorities by the Pinal County CWPP Working Group.

*Note*: Individual agencies will be able to seek letters of support from the Pinal County CWPP Working Group or partner agencies in applying for funding for projects identified as priorities by the Working Group.

3. Support fire departments and districts and other agencies and community groups in the implementation of projects established as priorities by the Pinal County CWPP Working Group.
4. Compile annual monitoring and reporting to provide information on additional measures necessary to meet Pinal County CWPP goals, including additional future recommendations from fire departments and districts and other agencies for inclusion in the priorities list.
5. Act as an advisory group to Pinal County Planning and Zoning and to developers in outlying areas to ensure adequate road conditions and to provide vegetation mitigation and landscaping recommendations, water supplies for emergency services, and recommendations for establishing and funding fire services and equipment in residential and commercial developments.
6. Recommend the establishment of fire services in grandfathered developments within the WUI when residential and commercial densities and vegetation/fuel-load factors reach levels that create a potential for high wildland fire risk to public and firefighter safety and private property protection.
7. Use the following general criteria for prioritizing proposed projects and action items:
    a. Geographic/fuel-load/residential density:
        i. The Top of the World, Oracle, Superior, and Queen Valley sub-WUIs will receive long-term priority due to vegetation, high fuel load, ignition history, and threatened communities.
        ii. In any given year, the Pinal County CWPP Working Group will evaluate countywide weather, vegetation, and fuel-load conditions and projections, as well as current residential and commercial densities, to determine short-term priority adjustments for projects in all WUI areas of the county for that year.
        iii. In any given year, the Pinal County CWPP Working Group will evaluate the progress of new developments and increasing residential and commercial densities to determine potential needs and priorities within the WUI for the next 3 years following that given year.
    b. Categorical/functional criteria—priorities will generally be established in the order listed below; these priorities are subject to review and change by the Pinal County CWPP Working Group on an ongoing basis:
        i. Fuel modification projects (first priorities will be for those projects within fire-department and fire-district, CNF, TNF, BLM, or ASFD jurisdictions)
        ii. Enhanced wildland firefighter training and acquisition of PPE
        iii. Wildland-fire suppression equipment and tools, including brush engines and tenders
        iv. Water-storage sites and supply facilities
        v. Community planning and outreach activities, including warning signs/systems, identification/improvement of evacuation routes
        vi. Radios for primary use by trained and designated wildland fire crews
        vii. Helicopter pads for firefighter deployment or evacuation

viii. Structural fire engines

ix. Fire stations in areas with sufficiently high threat and population densities as determined annually by the Pinal County CWPP Working Group.

x. Other communications projects

The agencies involved in the formation of this plan support local community efforts and will work with the communities as needed to accomplish action items. BLM, CNF, TNF, ASFD, PCOEM, and fire departments and districts will coordinate fuel mitigation projects on state, public, and forest lands within the WUI in coordination with the Pinal County CWPP Working Group when established. The Core Teams and the proposed Pinal County CWPP Working Group will be responsible for submitting grants and soliciting other opportunities to implement wildland fuel mitigation projects on private lands and to support public information, education, and outreach within the WUI. Successful award of grant funds will be used to implement the action recommendations for private land treatments, mitigation features for reduced structural ignitability, firefighting response, and public outreach. BLM, CNF, TNF, ASFD, PCOEM, fire departments and districts, and the Core Teams will pursue funding to construct and maintain firebreaks as well as broader applications of wildland fuel mitigation projects within the WUI. Annual monitoring and reporting compiled by the Pinal County CWPP Working Group will provide information on additional measures necessary to meet Pinal County CWPP goals.

### B. Priorities for Mitigation of Hazardous Wildland Fuels

Table 4.1 displays the priority for constructing firebreaks and landscape wildland fuel treatments within the WUI as recommended by the Core Teams. These action recommendations will reduce wildfire potential to the community and have “high” valuations for reducing wildland fire risk. The Core Teams recognize that not all acres within a high-risk landscape can be treated. Site-specific analysis will determine treatment acres and methods that produce a fire-resilient vegetative stand appropriate for the habitat.

### C. Identified Action Items for Protection Capability and Reduced Structural Ignitability

The Core Teams and collaborators will evaluate, maintain, and, where necessary, upgrade community wildfire preparation and response facilities, capabilities, and equipment. Table 4.2 lists the identified action items proposed by the Core Teams for consideration by individual fire departments and districts for structural ignitability and public outreach within their respective jurisdictions. Table 4.3 lists the future recommendations for wildland fire protection and reduced ignitability.

The Pinal County CWPP Working Group will meet within 2 months of the ASFD’s final approval of the Pinal County CWPP to prioritize projects on a countywide basis for the upcoming year and, thereafter, at least annually to reevaluate projects and reallocate priorities as needed. Such countywide prioritization will not impinge on or interfere with the fire departments’ and districts’ rights to independently seek funding for projects within their jurisdictions without Pinal County CWPP Working Group support.

**Table 4.1.** Action recommendations for wildland fuel modification

| Management area | Location and description | Project partner | Estimated treatment cost[a] |
|---|---|---|---|
| TW1 | Lands surrounding the community of Top of the World | PCOEM, ASFD, and TNF | 14,267 high-risk acres, FY 2009/2012 = $599,467.00/year; cost estimated to average $300.00/acre on federal and ASLD lands and $12,000.00/acre on private lands |
| O7 | General vicinity of Oracle and lands south to the WUI boundary with the CNF | PCOEM, ASLD, ASFD, CNF, BLM, and Oracle Fire District | 6,980 high-risk acres, FY 2009-12 = $846,967.00/year; cost estimated to average $300.00/acre on federal and ASLD lands and $12,000.00/acre on private lands |
| S3 | General vicinity of Superior and area immediately north of community | PCOEM, ASFD, TNF, and Superior Fire District | 3,405 high-risk acres, FY 2009–12 = $210,733.00/year; cost estimated to average $300.00/acre on nonfederal lands and $12,000.00/acre on private lands |
| QV1 | Queen Valley and lands north and east of community | PCOEM, ASFD, and Queen Valley Fire District | 4,567 high-risk acres, FY 2009–12 = $331,533.00/year; cost estimated to average $300.00/acre on nonfederal lands and $12,000.00/acre on private lands |
| AJ1 | Area on the northern and eastern boundary of Pinal County CWPP with TNF | PCOEM, ASFD, TNF, and Apache Junction Fire District | 8,250 high-risk acres, FY 2009–12 = $712,200.00/year; cost estimated to average $300.00/acre on nonfederal lands and $12,000.00/acre on private lands |
| Firebreak maintenance | 1- to 2-year rotating maintenance of fine and light fuels in Firebreaks TW1, O2, S1, QV1, and AJ1 | ASLD, ASFD, CNF, TNF, PCOEM, and participating fire departments and districts | 500 acres/year of light understory fuel treatments in excess of 4 acres treated/10-hour day at $830.00/day costs = $415,000.00/year |

[a]Total acres to be treated during the life of the plan; one-third of acres estimated to be treated based on site-specific analysis, which will determine actual acres available for treatment in each area.

**Table 4.2.** Action recommendations for structural ignitability and public outreach

| Project partner | Recommendation type | Specific recommendation | Estimated cost | Timeline |
|---|---|---|---|---|
| PCOEM, TNF, CNF, ASFD, ASLD, and fire departments and districts | 1.2 Wildland Fire Protection and Reduced Ignitability | Construct a series of 5,000-gal water-storage facilities located strategically throughout residential areas | Install water-storage facility/year: $5,000.00/facility | Locate and install 1 water-storage facility in 2009 |
| | 1.3 Enhanced Public Education, Information, and Outreach | Work with land agencies for the acquisition, operation, and maintenance of a green-waste disposal site within reasonable proximity to community | Locate and coordinate with land-management agency; excavate pit and fence: $20,000.00 | Begin planning with agencies in FY 2009/10; implement in FY 2010/11 |
| PCOEM, TNF, CNF, ASFD, ASLD, and fire departments and districts | | Obtain 10 handheld programmable radios for firefighter dispatch and communication | King digital programmable handheld radios, $1,380.00/radio: $13,800.00 | Obtain grant funding in 2010 |
| PCOEM, TNF, CNF, ASFD, ASLD, and fire departments and districts | 1.3 Enhanced Public Education, Information, and Outreach | Develop a fire-safety awareness program for community groups | Promote and conduct a community fire-awareness day at local fire departments and districts: $2,000.00 | Solicit funds for promotion, brochures, and event materials in 2009; conduct in 2009 |
| | | Create fire-safety and fire-awareness posters for public places | Development, printing, and distribution costs: $5,000.00 | Solicit funds for production and printing in 2009; publish and post in 2009 |

### D. Priorities for Promoting Community Involvement through Education, Information, and Outreach

The PCOEM and the Core Teams will implement public outreach and education programs for residents to heighten awareness and understanding of the threat that wildland fire poses to the community.

Table 4.4 displays the Pinal County CWPP priority recommendations to promote community involvement. Additional programs that could be used or developed to enhance community outreach and education may be developed and implemented in the future. The Core Teams will use the resources of the ASFD and BLM for additional public education programs and community outreach. Community bulletins and other public service announcements concerning wildfire threat and preparedness should be developed with assistance from ASFD and BLM.

**Table 4.3.** Future recommendations for wildland-fire protection and reduced ignitability

| Project partner | Project[a] | Equipment/expense | Timeline |
|---|---|---|---|
| PCOEM, ASFD, FS, and associated fire departments and districts | **E1—**Obtain a medium-size water tender to better able traverse rural landscape than larger units | 1,500-gal water tenders, 4-wheel drive: $65,000.00 | Acquire tender in FY 2010/11; assess additional tender needs in FY 2010/11 |
| PCOEM, ASFD, FS, and associated fire departments and districts | **E2—**Acquire and implement the emergency contact autophone redial public notification system with trained operators | Enhancement of existing radio repeater and autophone redial software and hardware | Assess costs in FY 2010; install in FY 2011/12 |
| PCOEM, ASFD, FS, and associated fire departments and districts | **I1—**Retrofit existing wells or water supplies for local fire department/district use (outlet pipes, valves, and hose thread adaptors); maintain sites; cost-share hose and nozzle for immediate protection at site | Pipe and valve installation and site maintenance: $10,000.00 initial, $2,500.00 annually | Begin in FY 2010/11; maintain annually |
| PCOEM, ASFD, CNF, TNF, BLM, and associated fire departments and districts | **A1—**Develop and maintain written mutual-aid agreements with neighboring fire departments and districts for wildland fire, structure fire, and other emergency response | Staff time, coordination efforts, research, and meetings: $5,000.00 | Inventory existing agreements; determine deficiencies and implement any needed agreements in FY 2011/12 |
| PCOEM, ASFD, CNF, TNF, BLM, and associated fire departments and districts | **A2—**Work with Pinal County to develop a notification and evacuation plan for the community | Staff time, coordination efforts, research, and meetings: $5,000.00 | Begin planning in FY 2010/11; implement in FY 2012 |
| PCOEM, ASFD, CNF, TNF, BLM, APS, SRP and associated fire departments and districts | **A3—**Work with SRP and APS on vegetative management treatments within and adjacent to utility corridors where opportunities exist | Staff time, coordination efforts, research, and meetings: $5,000.00 | Begin planning in FY 2010/11; implement in FY 2012 |
| PCOEM, ASFD, CNF, TNF, BLM, and associated fire departments and districts | **A4—**Develop a presuppression plan with FS, BLM, ASFD and local fire departments and districts along eastern and western boundary of Mount Tipton Wilderness | Staff time, coordination efforts, research, and meetings: $5,000.00 | Begin planning in FY 2010/11; implement in FY 2010/11 |

[a] Projects are designated by project type (E = equipment, I = infrastructure, A = administrative) but not ranked in order of importance.

**Table 4.4.** Future recommendations for enhanced public education, information, and outreach

| Project partner | Project | Equipment/expense | Timeline |
|---|---|---|---|
| PCOEM, CNF, TNF, BLM, ASFD, and associated fire departments and districts | Establish and maintain roadside fire-danger warning signs and other informational and directional road signs along major roads as determined by the Pinal County Fire Officers Association | Construction and placement: $5,000.00 | Construct and implement in FY 2010/11 |
| | Create and distribute community bulletin | Development, printing, and distribution costs: $5,000.00 | Develop in FY 2009; distribute continually |
| | Acquire Redzone or equivalent software and field data recorders or PDAs (personal digital assistants) to complete home fire assessments and implement fire-safe recommendations | Software and data recorder: $1,300.00<br>Assessment completion: $2,000.00 | Acquire software and complete assessments in FY 2010/11; implement recommendations in FY 2011 |
| | Encourage private businesses that perform Firewise land treatments; encourage market development of WUI by-products from vegetative fuel mitigation programs | Marketing plan to be developed | Initiate community marketing planning meetings in FY 2011 |
| | Replace and maintain fencing adjacent to high OHV (off-highway vehicle) use areas | Assess in 2011, initial plan for 1 mile of new or repaired fencing | Estimate $6,000.00m per mile of standard 4-wire fencing |

# V. MONITORING PLAN

Monitoring is essential to ensure that Pinal County CWPP goals are met. As Pinal County CWPP administrators, the local fire departments and districts, PCOEM, ASFD, CNF, TNF, and BLM will actively monitor the progress of the Pinal County CWPP action recommendations to determine the effectiveness of ongoing and completed projects in meeting Pinal County CWPP objectives, as well as to recommend future projects necessary to meet Pinal County CWPP goals.

In accordance with Section 102.g.5 of HFRA, Pinal County CWPP communities will participate in any multiparty monitoring program established by state and federal agencies, or other interested parties, to assess progress toward meeting Pinal County CWPP objectives. This authority to participate in multiparty monitoring will be vested in the Pinal County CWPP administrators. The Core Teams believe that participation in multiparty monitoring will provide effective and meaningful ecological and socioeconomic feedback on landscape and site-specific fuel reduction projects and watershed enhancements and will also help BLM, ASFD, PCOEM, and ASLD with land-management planning.

The Pinal County CWPP administrators will request participation in any post-wildfire analysis and burned area emergency response (BAER) planning with lead state or federal agencies. Immediate post-wildfire analysis and planning is essential to Pinal County to enhance public safety from possible flood and debris flows, municipal watershed pollution, and other post-wildfire habitat and community impacts.

This section details the performance measures that will be used to assess the effectiveness of implementing the Pinal County CWPP action recommendations. Monitoring will include assessing and evaluating the success of individual Pinal County CWPP project implementation and a given project's effectiveness in furthering Pinal County CWPP objectives.

## A. Administrative Oversight, Monitoring, and Pinal County CWPP Reporting

The Pinal County CWPP administrators, composed of the Fire Chief Association of Pinal County, PCOEM, CNF, TNF, ASFD, and BLM, will be mutually responsible for implementing and monitoring Pinal County CWPP action recommendations in coordination with a future established countywide community Working Group. The Pinal County CWPP administrators should identify appropriate grant and other funding mechanisms necessary to implement the action recommendations of the Pinal County CWPP. Grant information should be routinely searched to identify updated grant application cycles. In addition to the resources listed in Appendix C of this CWPP, the following is a list of federal, state, and nongovernmental Web sites that can be monitored to obtain updated information about grant application cycles:

**Federal**

- www.fs.fed.us/r3
- www.fs.fed.us/r3/partnerships/
- www.fireplan.gov
- www.firegrantsuport.com
- www.az.nrcs.usda.gov
- www.blm.gov/az

- www.firewise.org
- www.ncwg.gov

**State**

- www.azsf.az.gov
- www.azgfd.gov
- www.cals.arizona.edu/firewise
- www.southwestareagrants.org

**Nongovernmental**

- www.iwjv.org
- www.sonoran.org
- www.iafc.org

As needed, the Pinal County CWPP administrators in coordination with a future established countywide community Working Group will produce a report detailing the success of Pinal County CWPP project implementation and overall progress toward meeting Pinal County CWPP goals. The administrators should report successful grant awards received for implementing the Pinal County CWPP action recommendations to Pinal County CWPP signatories. The Pinal County CWPP administrators' report will also include recommendations to the signatories for updating the Community Mitigation Plan and the Prevention and Loss Mitigation Plan portions of the Pinal County CWPP, through the use of the principles of adaptive management. This information will ensure timely decision making for all levels of government and will provide input necessary for developing future work plans and for prioritizing project recommendations over the life of the Pinal County CWPP. Appendix D provides information on the data used in the analysis of the Pinal County CWPP and the appropriate contacts for updating the Pinal County CWPP. Once the Pinal County CWPP is updated, it will be submitted to the PCOEM, the Arizona State Forester, all participating fire departments and districts, municipal governments, CNF, TNF, and BLM for their concurrence. Once concurrence is achieved, the action recommendations of the updated Pinal County CWPP are to be forwarded for funding through HFRA and other appropriate funding sources.

### B. Effectiveness Monitoring

Table 5.1 outlines the performance measures that the Pinal County CWPP administrators will use to assess Pinal County CWPP performance against goals for the fiscal year. In addition to monitoring the listed performance measures, Pinal County CWPP administrators should assess the current status of wildland fuel hazards and look for any new or developing issues not covered by the Pinal County CWPP. As new issues arise, such as new invasive-species infestations, further risks and recommendations for treatment should be identified, and the Pinal County CWPP should be updated or amended as necessary to meet the Pinal County CWPP goals. To help track fuel treatments being planned and completed through local, state, and federal programs, the Pinal County CWPP administrators will cooperate by providing requested detailed mapping information to the Arizona State Forester's office.

**Table 5.1.** Performance measures to assess Pinal County CWPP progress

| Goal | Performance measure |
|---|---|
| **Improve fire prevention and suppression** | Reduction of wildland fire occurrence and acres burned (unplanned) in the WUI:<br>• PCOEM has implemented an emergency notification (autophone redial system) and evacuation plan.<br>• Wildland fire preplans for all high-hazard locations across Pinal County have been adopted.<br>• Local fire departments and districts have developed IGAs with Pinal County on nuisance-abatement projects located in high-hazard communities.<br>• Effectiveness monitoring of fire prevention and suppression will include the following:<br>— Acres burned and degree of severity of wildland fire<br>— Percentage of wildland fire controlled on initial attack<br>— Number of homes and structures lost to wildland fire<br>• New water sources developed in key areas.<br>• Consistent fire training in use<br>• Wildland firefighter PPE acquired as needed.<br>• Mutual-aid agreements with neighboring fire departments and districts updated and approved. |
| **Reduce hazardous vegetative fuels** | Effective treatment of high-risk areas effectively by acre:<br>• Number of treated acres of nonfederal WUI lands that are in Condition Class 2 or 3 are identified as high priorities by the Pinal County CWPP and should be moved to Condition Class 1 or another acceptable level of wildland fuel loading and continuity.<br>• Acres treated to acceptable fuel levels within priority treatment management areas.<br>• Total acres treated through any fuel reduction measures, including Rx, that are conducted in, or adjacent to, the WUI. The change of condition class should be determined for small projects or treatment areas through the use of the LANDFIRE database. |
| **Restore watershed health** | Acres of fuel reduction or watershed enhancement treatments that meet restoration treatment guidelines for riparian habitats:<br>• Coordination with and support of PCOEM, ASFD, ASLD, and BLM in implementing and determining social, economic, and environmental effects of riparian restoration treatments (Treatments 7 and 9, see Table 3.1 in mitigation plan).<br>• Acres of saltcedar-invaded riparian areas identified and undergoing restoration treatments. |
| **Promote community involvement** | Initiation of public outreach programs:<br>• Countywide community Working Group initiated.<br>• Public outreach programs and promotions implemented to enhance volunteer efforts to reduce hazardous fuels.<br>• Number and areas (community or dispersed residents) of private landowners supporting and implementing fuel reduction projects.<br>• PCOEM and local fire departments and districts developed and implemented evacuation plans for identified high-risk areas.<br>• Individual home assessments completed in WUI boundary high-risk areas.<br>• Roadside fire-danger warning signs in English and Spanish installed at strategic points within the WUI.<br>• Green-waste disposal and processing site secured and operational.<br>• Fire-awareness articles printed in local newspapers.<br>• Fire-safety awareness program, posters, and information available in public places. |
| **Encourage economic development** | Wood-products industry growth and diversification to use all sizes of material removed by fuel reduction treatments:<br>• Number of value-added wood products developed by the community.<br>• Number of new markets (local firewood sales) for local products created. |

# VI. DECLARATION OF AGREEMENT AND CONCURRENCE

The following partners in the development of the Pinal County Community Wildfire Protection Plan have reviewed and do mutually agree or concur with its contents:

## Agreement

| | |
|---|---|
| Pinal County Board of Supervisors | Date |
| City of Casa Grande | Date |
| City of Apache Junction | Date |
| Town of Florence | Date |
| Town of Kearny | Date |
| Town of Maricopa | Date |
| Town of Superior | Date |
| Town of Coolidge | Date |
| Arizona Public Service Company | Date |
| Salt River Project | Date |

| | |
|---|---|
| Apache Junction Fire District | Date |
| Arizona City Fire District | Date |
| Avra Valley Fire District | Date |
| Dudleyville Fire District | Date |
| Eloy Fire District | Date |
| Golder Ranch Fire District | Date |
| Mammoth Fire District | Date |
| Oracle Fire District | Date |
| Queen Valley Fire District | Date |
| San Manuel Fire District | Date |

| | |
|---|---|
| Stanfield Fire District | Date |
| Thunderbird Fire District | Date |
| Casa Grande Fire Department | Date |
| Coolidge Fire Department | Date |
| Florence Fire Department | Date |
| Kearny Fire Department | Date |
| Maricopa Fire Department | Date |
| Superior Fire Department | Date |

## Concurrence

| | |
|---|---|
| Arizona State Forester<br>Arizona State Forestry Division | Date |
| Phoenix District Manager<br>Bureau of Land Management | Date |
| Gila District Manager<br>Bureau of Land Management | Date |
| Globe District Ranger<br>Tonto National Forest | Date |
| Mesa District Ranger<br>Tonto National Forest | Date |
| Catalina District Ranger<br>Coronado National Forest | Date |

# VII. REFERENCES

Anderson, H. E. 1982. *Aids to Determining Fuel Models for Estimating Fire Behavior.* INT-122. National Wildlife Coordinating Group, Washington, DC.

Arizona Department of Commerce. 2007. Community Profiles. http://www.azcommerce.com.

Arizona Wildlands Invasive Plant Working Group (AZ-WIPWG). 2005. *Invasive Non-Native Plants that Threaten Wildlands In Arizona: A Categorized List Developed by the Arizona Wildland Invasive Plant Working Group*. August.

Arizona State Forester. 2004. *Arizona Wildland Urban Interface Assessment*. http://www.azstatefire.org.

Arizona State Forester. 2007a. *Arizona-Identified Communities at Risk.* http://www.azstatefire.org.

Arizona State Forester. 2007b. *Identifying Arizona's Wildland/Urban Interface Communities at Risk: A Guide for State and Federal Land Managers*.

Buffelgrass Working Group. 2008. *Southern Arizona Buffelgrass Strategic Plan.* February.

Burgan, Robert E. 1988. 1988 Revisions to the 1978 National Fire-Danger Rating System. Research Paper SE-273. USDA Forest Service, Southeastern Forest Experiment Station, Asheville, NC.

Cohen, Jack. 2008. *The Wildland Urban Interface Fire Problem A Consequence of the Fire Exclusion Paradigm.* Forest History Society. Forest History Today. Fall 2008. http://www.ForestHistory.org.

Communities Committee of the Seventh American Forest Congress, Society of American Foresters, the National Association of State Foresters (NASF), the National Association of Counties, and the Western Governors Association (WGA). 2004. *Preparing a Community Wildfire Protection Plan: A Handbook for Wildland-Urban Interface Communities*.

Fire Regime Condition Class (FRCC) Interagency Working Group. 2005a. *Fire Regime Condition Class (FRCC) Interagency Handbook Reference Conditions*. Fire Regime Condition Class (FRCC) Potential Natural Vegetation Group (BpS) Descriptions. http://www.frcc.gov/pnvgSummaries.html.

FRCC Interagency Working Group. 2005b. *Interagency Fire Regime Condition Class Guidebook*. Fire Regime Condition Class Version 1.2.
http://www.frcc.gov/docs/1.2.2.2/Complete_Guidebook_V1.2.pdf.

Gori, D. F., and C. A. F. Enquist. 2003. *An Assessment of the Spatial Extent and Condition of Grasslands in Central and Southern Arizona, Southwestern New Mexico and Northern Mexico*. The Nature Conservancy, Arizona Chapter.

Governor's Arizona Forest Health Oversight Council. 2006. *2006 Status Report and Recommendations.* Executive Order 2003-16. Final. April 25.

Governor's Forest Health Councils, State of Arizona. 2007. *The Statewide Strategy for Restoring Arizona's Forests*, edited by E. Aumack, T Sisk, and J. Palumbo. Arizona Public Service, Phoenix. June.

Hendricks, David, M. 1985. *Arizona Soils*. College of Agriculture, University of Arizona. Tucson.

Hauser, A. Scott. 2008. *Pennisetum ciliare.* In *Fire Effects Information System*. US Department of Agriculture, Forest Service, Rocky Mountain Research Station, Fire Sciences Laboratory (Producer). http://www.fs.fed.us/database/feis/.

National Association of State Foresters. 2003. *Field Guidance: Identifying and Prioritizing Communities At Risk.* http://www.stateforesters.org/reports/COMMUNITIESATRISKFG.pdf.

National Fire and Aviation Executive Board. 2007. Clarification of Appropriate Management Response. http://www.nifc.gov/fire_policy/.

National Wildfire Coordinating Group. 2006. *Re-release of NWCG Interagency Wildland Fire Key Messages.* National Interagency Fire Center, Boise, ID.

Natural Resource Conservation Service (NRCS). 2002. *National Conservation Practice Standards, Range Planting*. Code 550.

NRCS. 2007. *National Cooperative Soil Survey Rangeland Productivity and Plant Composition-Pima County, Eastern Part*.

NatureServe. 2004. *Southwest ReGAP Analysis Project- Land Cover Data Legend Descriptions*. http://earth.gis.usu.edu/swregap/legend_desc.html.

Oracle Fire District. 2008. *Oracle Community Wildfire Protection Plan*.

Presidential Policy. 2002. *Healthy Forests: An Initiative for Wildfire Prevention and Stronger Communities*. August 22.

Rogstad, Alex. Ed. 2008. *Southern Arizona Bufflegrass Strategic Plan. A Regional Guide for Control, Mitigation and Restoration*. Arizona-Sonora Desert Museum, Tucson.

San Juan County Watershed Group. 2005. *San Juan Basin Watershed Management Plan*.

Schmidt, K. M., J. P. Menakis, C. C. Hardy, W. J. Hann, and D. L. Bunnell. 2002. *Development of Coarse-Scale Spatial Data for Wildland Fire and Fuel Management.* RMRS-87. USDA Forest Service, Washington, DC.

Scott, Joe H., and Robert E. Burgan. 2005. Standard fire behavior fuel models: A comprehensive set for use with Rothermel's surface fire spread model. Gen. Tech. Rep. RMRS-GTR-153. US Department of Agriculture, Forest Service, Rocky Mountain Research Station, Fort Collins, CO.

US Census Bureau. 2008. Pinal County, Arizona, ACS [American Community Survey] Demographic and Housing Estimates: 2007. American FactFinder. http://factfinder.census.gov/.

US Department of Agriculture Forest Service (USDA FS). 1978. *The National Fire Danger Rating System*. GTR INT-39.

USDA FS. 2000. USDA Forest Service Handbook 1909. Washington, DC.

USDA FS. 2003. *Fire Regime and Condition Class (FRCC) Field Procedures—Standard and Scorecard Methods.* FIREMON v1.1 – 10/30/03-1. Washington, DC.

USDA FS. 2005a. *Coronado National Forest Land and Resource Management Plan*. Coronado National Forest, Tucson.

USDA FS. 2005b. *Wildland Fire Amendment to the Coronado National Forest Land and Resource Management Plan*. Coronado National Forest, Tucson.

USDA FS. 2006. *Amendment 25 to the Tonto National Forest Land and Resource Management Plan*. Tonto National Forest, Mesa.

USDA FS and New Mexico Energy, Minerals and Natural Resources Department, Forestry Division. 2005. *Strategy for Long-Term Management of Exotic Trees in Riparian Areas for New Mexico's Five River Systems, 2005-2014*.

USDA FS and USDI Bureau of Land Management (USDI BLM). 2002. *A Collaborative Approach for Reducing Wildland Fire Risks to Communities and the Environment: 10-Year Comprehensive Strategy Implementation Plan*. Washington, DC.

USDA FS and USDI BLM. 2004a. *The Healthy Forests Initiative and Healthy Forests Restoration Act: Interim Field Guide.* FS-799. Washington, DC.

USDA FS and USDI BLM. 2004b. *National Fire Plan*. Washington, DC. http://www.fireplan.gov, accessed March 2008.

USDA and USDI. 2001a. "Urban Wildland Interface Communities within the Vicinity of Federal Lands That Are at High Risk from Wildfire," *Federal Register* Vol. 66, no. 3, pp. 751–777. January 4.

USDA and USDI. 2001b. "Urban Wildland Interface Communities within the Vicinity of Federal Lands That Are at High Risk from Wildfire" (update), *Federal Register* Vol. 66, no. 160, pp. 43383–43435. August 17.

USDI BLM. 2004a. *Approved Arizona Statewide Land Use Plan Amendment for Fire, Fuels, and Air Quality Management and Decision Record*.

USDI BLM. 2004b. Wildland Fire Suppression (Including Wildland Fire Use) and Rehabilitation in Riparian and Aquatic Habitats (RA).

USDI and USDA 2005. *Wildland Fire Use Implementation Procedures Reference Guide*. May 2005.

US Geological Survey (USGS) National GAP Analysis Program. 2005. Southwest Regional GAP Analysis Project—Land Cover Data Legend Descriptions. RS/GIS Laboratory, College of Natural Resources, Utah State University. http://ftp.nr.usu.edu/swgap/legend_desc.html.

Wildland Fire Leadership Council. 2002. Memorandum of Understanding. http://www.fireplan.gov/leadership/memorandum.html.

Zouhar, K. 2003. *Tamarix* spp. Fire Effects Information System (online). USDA Forest Service, Rocky Mountain Research Station, Fire Sciences Laboratory(Producer). http://www.fs.fed.us/database/feis/.

## VIII. GLOSSARY OF FIRE MANAGEMENT TERMS

### A

*Aerial Fuels*: All live and dead vegetation in the forest canopy or above surface fuels, including tree branches, twigs and cones, snags, moss, and high brush.

*Aerial Ignition*: Ignition of fuels by dropping incendiary devices or materials from aircraft.

*Air Tanker*: A fixed-wing aircraft equipped to drop fire retardants or suppressants.

*Agency*: Any federal, state, county, or city government organization participating with jurisdictional responsibilities.

*Anchor Point*: An advantageous location, usually a barrier to fire spread, from which to start building a fire line. An anchor point is used to reduce the chance of firefighters being flanked by fire.

*Appropriate Tools*: Methods for reducing hazardous fuels including prescribed fire, wildland fire use, and various mechanical methods such as crushing, tractor and hand piling, thinning (to produce commercial or pre-commercial products), and pruning. They are selected on a site-specific case and are ecologically appropriate and cost effective.

*Aramid*: The generic name for a high-strength, flame-resistant synthetic fabric used in the shirts and jeans of firefighters. Nomex, a brand name for aramid fabric, is the term commonly used by firefighters.

*Aspect*: Direction toward which a slope faces.

### B

*Backfire*: A fire set along the inner edge of a fireline to consume the fuel in the path of a wildfire and/or change the direction of force of the fire's convection column.

*Backpack Pump*: A portable sprayer with hand-pump, fed from a liquid-filled container fitted with straps, used mainly in fire and pest control. (see Bladder Bag)

*Bambi Bucket*: A collapsible bucket slung below a helicopter. Used to dip water from a variety of sources for fire suppression.

*Behave*: A system of interactive computer programs for modeling fuel and fire behavior that consists of two systems: BURN and FUEL.

*Bladder Bag*: A collapsible backpack portable sprayer made of neoprene or high-strength nylon fabric fitted with a pump. (see Backpack Pump)

*Blow-up*: A sudden increase in fire intensity or rate of spread strong enough to prevent direct control or to upset control plans. Blow-ups are often accompanied by violent convection and may have other characteristics of a fire storm. (see Flare-up)

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Glossary adapted from the NIFC, http://www.nifc.gov/fireinfo/glossary.html (2006). See also the *Glossary of Wildland Fire Terminology*, http://www.nwcg.gov (National Wildfire Coordinating Group, Incident Operations Standards Working Team, 2007).

*Brush*: A collective term that refers to stands of vegetation dominated by shrubby, woody plants, or low growing trees, usually of a type undesirable for livestock or timber management.

*Brush Fire*: A fire burning in vegetation that is predominantly shrubs, brush and scrub growth.

*Bucket Drops*: The dropping of fire retardants or suppressants from specially designed buckets slung below a helicopter.

*Buffer Zones*: An area of reduced vegetation that separates wildlands from vulnerable residential or business developments. This barrier is similar to a greenbelt in that it is usually used for another purpose such as agriculture, recreation areas, parks, or golf courses.

*Bump-up Method*: A progressive method of building a fire line on a wildfire without changing relative positions in the line. Work is begun with a suitable space between workers. Whenever one worker overtakes another, all workers ahead move one space forward and resume work on the uncompleted part of the line. The last worker does not move ahead until completing his or her space.

*Burnable Acres*: Any vegetative material/type that is susceptible to burning.

*Burned Area Rehabilitation*: The treatment of an ecosystem following fire disturbance to minimize subsequent effects. (1995 Federal Wildland Fire Policy.)

*Burn Out*: Setting fire inside a control line to widen it or consume fuel between the edge of the fire and the control line.

*Burning Ban*: A declared ban on open air burning within a specified area, usually due to sustained high fire danger.

*Burning Conditions*: The state of the combined factors of the environment that affect fire behavior in a specified fuel type.

*Burning Index*: An estimate of the potential difficulty of fire containment as it relates to the flame length at the most rapidly spreading portion of a fire's perimeter.

*Burning Period*: That part of each 24-hour period when fires spread most rapidly, typically from 10:00 a.m. to sundown.

*Burn Intensity*: The amount and rate of surface fuel consumption. It is not a good indicator of the degree of chemical, physical and biological changes to the soil or other resources. (see Fire Severity)

**C**

*Campfire*: As used to classify the cause of a wildland fire, a fire that was started for cooking or warming that spreads sufficiently from its source to require action by a fire control agency.

*Candle or Candling*: A single tree or a very small clump of trees that is burning from the bottom up.

*Catastrophic*: Fire that burns more intensely than the natural or historical range or variability, thereby fundamentally changing the ecosystem, destroying communities and/or rare or threatened species/habitats, or causing unacceptable erosion [definition added from the *Proposed Statewide Land Use Plan for Fire, Fuels and Air Quality Management* (USDI Bureau of Land Management 2004)]. (see Severe Wildland Fire)

*Chain*: A unit of linear measurement equal to 66 horizontal feet.

*Closure*: Legal restriction, but not necessarily elimination of specified activities such as smoking, camping, or entry that might cause fires in a given area.

*Cold Front*: The leading edge of a relatively cold air mass that displaces warmer air. The heavier cold air may cause some of the warm air to be lifted. If the lifted air contains enough moisture, the result may be cloudiness, precipitation, and thunderstorms. If both air masses are dry, no clouds may form. Following the passage of a cold front in the Northern Hemisphere, westerly or northwesterly winds of 15 to 30 or more miles per hour often continue for 12 to 24 hours.

*Cold Trailing*: A method of controlling a partly dead fire edge by carefully inspecting and feeling with the hand for heat to detect any fire, digging out every live spot, and trenching any live edge.

*Command Staff*: The command staff consists of the information officer, safety officer and liaison officer. They report directly to the incident commander and may have assistants.

*Community Impact Zone (CIZ)*: The zone around a community that may be impacted by wildfire. Similar to Defensible Space, but on a community level.

*Complex*: Two or more individual incidents located in the same general area, which are assigned to a single incident commander or unified command.

*Condition Class*: Based on coarse scale national data, Fire Condition Classes measure general wildfire risk as follows:

> *Condition Class 1*. For the most part, fire regimes in this Fire Condition Class are within historical ranges. Vegetation composition and structure are intact. Thus, the risk of losing key ecosystem components from the occurrence of fire remains relatively low.
>
> *Condition Class 2*. Fire regimes on these lands have been moderately altered from their historical range by either increased or decreased fire frequency. A moderate risk of losing key ecosystem components has been identified on these lands.
>
> *Condition Class 3*. Fire regimes on these lands have been significantly altered from their historical return interval. The risk of losing key ecosystem components from fire is high. Fire frequencies have departed from historical ranges by multiple return intervals. Vegetation composition, structure and diversity have been significantly altered. Consequently, these lands verge on the greatest risk of ecological collapse. (Cohesive Strategy 2002, in draft)

*Contain a Fire*: A fuel break around the fire has been completed. This break may include natural barriers or manually and/or mechanically constructed line.

*Control a Fire*: The complete extinguishment of a fire, including spot fires. Fireline has been strengthened so that flare-ups from within the perimeter of the fire will not break through this line.

*Control Line*: All built or natural fire barriers and treated fire edge used to control a fire.

*Cooperating Agency*: An agency supplying assistance other than direct suppression, rescue, support, or service functions to the incident control effort; e.g., Red Cross, law enforcement agency, telephone company, etc.

*Coyote Tactics*: A progressive line construction duty involving self-sufficient crews that build fire line until the end of the operational period, remain at or near the point while off duty, and begin building fire line again the next operational period where they left off.

*Creeping Fire*: Fire burning with a low flame length and spreading slowly.

*Crew Boss*: A person in supervisory charge of usually 16 to 21 firefighters and responsible for their performance, safety, and welfare.

*Critical Ignition Zones*: Those areas that are likely to be key in the formation of large wildfires if ignition occurs at that location. These include locations such as at the bottom of a hill, or in fuels that will ignite easily and sustain growth of fire with increasing flame lengths and fire intensity.

*Crown Fire (Crowning)*: The movement of fire through the crowns of trees or shrubs more or less independently of the surface fire.

*Curing*: Drying and browning of herbaceous vegetation or slash.

**D**

*Dead Fuels*: Fuels with no living tissue in which moisture content is governed almost entirely by atmospheric moisture (relative humidity and precipitation), dry-bulb temperature, and solar radiation.

*Debris Burning*: A fire spreading from any fire originally set for the purpose of clearing land or for rubbish, garbage, range, stubble, or meadow burning.

*Defensible Space*: An area either natural or manmade where material capable of causing a fire to spread has been treated, cleared, reduced, or changed to act as a barrier between an advancing wildland fire and the loss to life, property, or resources. In practice, “defensible space” is defined as an area a minimum of 30 feet around a structure that is cleared of flammable brush or vegetation. (see Survivable Space)

*Deployment*: See Fire Shelter Deployment.

*Detection*: The act or system of discovering and locating fires.

*Direct Attack*: Any treatment of burning fuel, such as by wetting, smothering, or chemically quenching the fire or by physically separating burning from unburned fuel.

*Dispatch*: The implementation of a command decision to move a resource or resources from one place to another.

*Dispatcher*: A person employed who receives reports of discovery and status of fires, confirms their locations, takes action promptly to provide people and equipment likely to be needed for control in first attack, and sends them to the proper place.

*Dispatch Center*: A facility from which resources are directly assigned to an incident.

*Division*: Divisions are used to divide an incident into geographical areas of operation. Divisions are established when the number of resources exceeds the span-of-control of the operations chief. A division is located with the Incident Command System organization between the branch and the task force/strike team.

*Dozer*: Any tracked vehicle with a front-mounted blade used for exposing mineral soil.

*Dozer Line*: Fire line constructed by the front blade of a dozer.

*Drip Torch*: Hand-held device for igniting fires by dripping flaming liquid fuel on the materials to be burned; consists of a fuel fount, burner arm, and igniter. Fuel used is generally a mixture of diesel and gasoline.

*Drop Zone*: Target area for air tankers, helitankers, and cargo dropping.

*Drought Index*: A number representing net effect of evaporation, transpiration, and precipitation in producing cumulative moisture depletion in deep duff or upper soil layers.

*Dry Lightning Storm*: Thunderstorm in which negligible precipitation reaches the ground. Also called a dry storm.

*Duff*: The layer of decomposing organic materials lying below the litter layer of freshly fallen twigs, needles, and leaves and immediately above the mineral soil.

**E**

*Ecosystem*: A spatially explicit, relative homogeneous unit of the Earth that includes all interacting organisms and components of any part of the natural environment within its boundaries. An ecosystem can be of any size, e.g., a log, pond, field, forest, or the Earth's biosphere (Society of American Foresters, 1998).

*Ecosystem Integrity*: The completeness of an ecosystem that at geographic and temporal scales maintains its characteristics diversity of biological and physical components, composition, structure, and function (Cohesive Strategy, 2000).

*Energy Release Component (ERC)*: The computed total heat released per unit area (British thermal units per square foot) within the fire front at the head of a moving fire.

*Engine*: Any ground vehicle providing specified levels of pumping, water and hose capacity.

*Engine Crew*: Firefighters assigned to an engine. The *Fireline Handbook* defines the minimum crew makeup by engine type.

*Entrapment*: A situation where personnel are unexpectedly caught in a fire behavior-related, life-threatening position where planned escape routes or safety zones are absent, inadequate, or compromised. An entrapment may or may not include deployment of a fire shelter for its intended purpose. These situations may or may not result in injury. They include "near misses."

*Environmental Assessment (EA)*: EAs were authorized by the National Environmental Policy Act (NEPA) of 1969. They are concise, analytical documents prepared with public participation that determine if an Environmental Impact Statement (EIS) is needed for a particular project or action. If an EA determines an EIS is not needed, the EA becomes the document allowing agency compliance with NEPA requirements.

*Environmental Impact Statement (EIS)*: EISs were authorized by the National Environmental Policy Act (NEPA) of 1969. Prepared with public participation, they assist decision makers by providing information, analysis and an array of action alternatives, allowing managers to see the probable effects of decisions on the environment. Generally, EISs are written for large-scale actions or geographical areas.

*Equilibrium Moisture Content*: Moisture content that a fuel particle will attain if exposed for an infinite period in an environment of specified constant temperature and humidity. When a fuel particle reaches equilibrium moisture content, net exchange of moisture between it and the environment is zero.

*Escape Route*: A preplanned and understood route firefighters take to move to a safety zone or other low-risk area, such as an already burned area, previously constructed safety area, a meadow that won't burn, natural rocky area that is large enough to take refuge without being burned. When escape routes deviate from a defined physical path, they should be clearly marked (flagged).

*Escaped Fire*: A fire that has exceeded or is expected to exceed initial attack capabilities or prescription.

*Extended Attack Incident*: A wildland fire that has not been contained or controlled by initial attack forces and for which more firefighting resources are arriving, en route, or being ordered by the initial attack incident commander.

*Extreme Fire Behavior*: "Extreme" implies a level of fire behavior characteristics that ordinarily precludes methods of direct control action. One of more of the following is usually involved: high rate of spread, prolific crowning and/or spotting, presence of fire whirls, strong convection column. Predictability is difficult because such fires often exercise some degree of influence on their environment and behave erratically, sometimes dangerously.

**F**

*Faller*: A person who fells trees. Also called a sawyer or cutter.

*Field Observer*: Person responsible to the Situation Unit Leader for collecting and reporting information about an incident obtained from personal observations and interviews.

*Fine (Light) Fuels*: Fast-drying fuels, generally with a comparatively high surface area-to-volume ratio, which are less than 1/4-inch in diameter and have a timelag of one hour or less. These fuels readily ignite and are rapidly consumed by fire when dry.

*Fingers of a Fire*: The long narrow extensions of a fire projecting from the main body.

*Fire Behavior*: The manner in which a fire reacts to the influences of fuel, weather and topography.

*Fire Behavior Forecast*: Prediction of probable fire behavior, usually prepared by a Fire Behavior Officer, in support of fire suppression or prescribed burning operations.

*Fire Behavior Specialist*: A person responsible to the Planning Section Chief for establishing a weather data collection system and for developing fire behavior predictions based on fire history, fuel, weather and topography.

*Firebreak*: A natural or constructed barrier used to stop or check fires that may occur or to provide a control line from which to work.

*Fire Cache*: A supply of fire tools and equipment assembled in planned quantities or standard units at a strategic point for exclusive use in fire suppression.

*Fire Crew*: An organized group of firefighters under the leadership of a crew leader or other designated official.

*Fire Defense System*: The cumulative effect of the fire suppression system of a community, including fuels reduction programs, fire breaks, defensible space, and the response capabilities of emergency personnel.

*Fire Frequency*: The natural return interval for a particular ecosystem.

*Fire Front*: The part of a fire within which continuous flaming combustion is taking place. Unless otherwise specified the fire front is assumed to be the leading edge of the fire perimeter. In ground fires, the fire front may be mainly smoldering combustion.

*Fire Hazard Reduction Zone*: Home ignition zone area, where fuel reduction and home fire resistant projects should take place to reduce the risk of a wildfire damaging a structure.

*Fire Intensity*: A general term relating to the heat energy released by a fire.

*Fire Line*: A linear fire barrier that is scraped or dug to mineral soil.

*Fire Load*: The number and size of fires historically experienced on a specified unit over a specified period (usually one day) at a specified index of fire danger.

*Fire Management Plan (FMP)*: A strategic plan that defines a program to manage wildland and prescribed fires and documents the Fire Management Program in the approved land use plan. The plan is supplemented by operational plans such as preparedness plans, preplanned dispatch plans, prescribed fire plans, and prevention plans.

*Fire Management Planning*: A generic term referring to all levels and categories of fire management planning, including: preparedness, prevention, hazardous risk assessment, and mitigation planning.

*Fire Perimeter*: The entire outer edge or boundary of a fire.

*Fire-prone ecosystem*: Ecosystems that historically burned intensely at low frequencies (stand replacing fires), those that burned with low intensity at a high frequency (understory fires), and those that burned very infrequently historically, but are not subject to much more frequent fires because of changed conditions. These include fire-influenced and fire-adapted ecosystems (Cohesive Strategy, 2000).

*Fire Regime*: A generalized description of the role fire plays in an ecosystem. It is characterized by fire frequency, predictability, seasonality, intensity, duration, scale (patch size), as well as regularity or variability. Five combinations of fire frequency, expressed as fire return interval in fire severity, are defined:

> *Groups I and II* include fire return intervals in the 0–35 year range. Group I includes Ponderosa pine, other long needle pine species, and dry site Douglas fir. Group II includes the drier grassland types, tall grass prairie, and some Pacific chaparral ecosystems.
>
> *Groups III and IV* include fire return internals in the 35–100+ year range. Group III includes interior dry site shrub communities such as sagebrush and chaparral ecosystems. Group IV includes lodgepole pine and jack pine.
>
> *Group V* is the long interval (infrequent), stand replacement fire regime and includes temperate rain forest, boreal forest, and high elevation conifer species.

*Fire-Return Interval*: The number of years between successive fire events at a specific site or an area of a specified size.

*Fire Risk Reduction Zone*: A zone targeted for risk reduction, including measures such as fuels reduction, access protection, and construction of structures to minimize the risk of ignition from wildfire.

*Fire Season*: (1) Period(s) of the year during which wildland fires are likely to occur, spread, and affect resource values sufficient to warrant organized fire management activities. (2) A legally enacted time during which burning activities are regulated by state or local authority.

*Fire Severity*: The amount of heat that is released by a fire and how it affects other resources. It is dependent on the type of fuels and the behavior of the fuels when they are burned. (see Burn Intensity)

*Fire Shelter*: An aluminized tent offering protection by means of reflecting radiant heat and providing a volume of breathable air in a fire entrapment situation. Fire shelters should only be used in life-threatening situations, as a last resort.

*Fire Shelter Deployment*: The removing of a fire shelter from its case and using it as protection against fire.

*Firestorm*: A fire of great size and intensity that generates and is fed by strong inrushing winds from all sides; the winds add fresh oxygen to the fire, increasing the intensity.

*Fire Triangle*: Instructional aid in which the sides of a triangle are used to represent the three factors (oxygen, heat, fuel) necessary for combustion and flame production; removal of any of the three factors causes flame production to cease.

*Fire Use Module (Prescribed Fire Module)*: A team of skilled and mobile personnel dedicated primarily to prescribed fire management. These are national and interagency resources, available throughout the prescribed fire season, that can ignite, hold and monitor prescribed fires.

*Fire Use*: The combination of wildland fire use and prescribed fire application to meet resource objectives.

*Fire Weather*: Weather conditions that influence fire ignition, behavior and suppression.

*Fire Weather Watch*: A term used by fire weather forecasters to notify using agencies, usually 24 to 72 hours ahead of the event, that current and developing meteorological conditions may evolve into dangerous fire weather.

*Fire Whirl*: Spinning vortex column of ascending hot air and gases rising from a fire and carrying aloft smoke, debris, and flame. Fire whirls range in size from less than one foot to more than 500 feet in diameter. Large fire whirls have the intensity of a small tornado.

*Firewise*: A public education program developed by the National Wildland Fire Coordinating Group that assists communities located in proximity to fire-prone lands. (For additional information, see http://www.firewise.org)

*Firefighting Resources*: All people and major items of equipment that can or potentially could be assigned to fires.

*Flame Height*: The average maximum vertical extension of flames at the leading edge of the fire front. Occasional flashes that rise above the general level of flames are not considered. This distance is less than the flame length if flames are tilted due to wind or slope.

*Flame Length*: The distance between the flame tip and the midpoint of the flame depth at the base of the flame (generally the ground surface); an indicator of fire intensity.

*Flaming Front*: The zone of a moving fire where the combustion is primarily flaming. Behind this flaming zone, combustion is primarily glowing. Light fuels typically have a shallow flaming front, whereas heavy fuels have a deeper front. Also called fire front.

*Flanks of a Fire*: The parts of a fire's perimeter that are roughly parallel to the main direction of spread.

*Flare-up*: Any sudden acceleration of fire spread or intensification of a fire. Unlike a blow-up, a flare-up lasts a relatively short time and does not radically change control plans.

*Flash Fuels*: Fuels such as grass, leaves, draped pine needles, fern, tree moss and some kinds of slash, that ignite readily and are consumed rapidly when dry. Also called fine fuels.

*Forb*: A plant with a soft, rather than permanent woody stem, that is not a grass or grass-like plant.

*Fuel*: Combustible material. Includes, vegetation, such as grass, leaves, ground litter, plants, shrubs and trees, that feed a fire. (see Surface Fuels)

*Fuel Bed*: An array of fuels usually constructed with specific loading, depth and particle size to meet experimental requirements; also, commonly used to describe the fuel composition in natural settings.

*Fuel Loading*: The amount of fuel present expressed quantitatively in terms of weight of fuel per unit area.

*Fuel Model*: Simulated fuel complex (or combination of vegetation types) for which all fuel descriptors required for the solution of a mathematical rate of spread model have been specified.

*Fuel Moisture (Fuel Moisture Content)*: The quantity of moisture in fuel expressed as a percentage of the weight when thoroughly dried at 212 degrees Fahrenheit.

*Fuel Reduction*: Manipulation, including combustion, or removal of fuels to reduce the likelihood of ignition and/or to lessen potential damage and resistance to control. Incorporated within this are treatments to protect, maintain, and restore land health and desired fire cycles.

*Fuel Type*: An identifiable association of fuel elements of a distinctive plant species, form, size, arrangement, or other characteristics that will cause a predictable rate of fire spread or difficulty of control under specified weather conditions.

*Fusee*: A colored flare designed as a railway-warning device and widely used to ignite suppression and prescription fires.

**G**

*General Staff*: The group of incident management personnel reporting to the incident commander. They may each have a deputy, as needed. Staff consists of operations section chief, planning section chief, logistics section chief, and finance/administration section chief.

*Geographic Area*: A political boundary designated by the wildland fire protection agencies, where these agencies work together in the coordination and effective utilization of firefighting resources.

*Ground Fuel*: All combustible materials below the surface litter, including duff, tree or shrub roots, dried out dead wood, peat, and sawdust that normally support a glowing combustion without flame.

**H**

*Haines Index*: An atmospheric index used to indicate the potential for wildfire growth by measuring the stability and dryness of the air over a fire.

*Hand Line*: A fire line built with hand tools.

*Hazard Reduction*: Any treatment of a hazard that reduces the threat of ignition and fire intensity or rate of spread.

*Hazardous Fuels Reduction*: "Fuel Reduction" is defined as the manipulation or removal of fuels, including combustion, to reduce the likelihood of ignition and/or to lessen potential damage and resistance to control. Incorporated within this are treatments to protect, maintain, and restore land health and desired fire cycles. "Hazard Reduction" is defined as any treatment of a hazard that reduces the threat of ignition and fire intensity or rate of spread.

*Head of a Fire*: The side of the fire having the fastest rate of spread.

*Heavy Fuels*: Fuels of large diameter such as snags, logs, large limb wood, that ignite and are consumed more slowly than flash fuels.

*Helibase*: The main location within the general incident area for parking, fueling, maintaining, and loading helicopters. The helibase is usually located at or near the incident base.

*Helispot*: A temporary landing spot for helicopters.

*Helitack*: The use of helicopters to transport crews, equipment, and fire retardants or suppressants to the fire line during the initial stages of a fire.

*Helitack Crew*: A group of firefighters trained in the technical and logistical use of helicopters for fire suppression.

*Holding Actions*: Planned actions required to achieve wildland prescribed fire management objectives. These actions have specific implementation timeframes for fire use actions but can have less sensitive implementation demands for suppression actions.

*Holding Resources*: Firefighting personnel and equipment assigned to do all required fire suppression work following fireline construction but generally not including extensive mop-up.

*Home Ignitability*: The ignition potential within the Home Ignition Zone.

*Home Ignition Zone*: The home and its immediate surroundings. The home ignition zone extends to a few tens of meters around a home not hundreds of meters or beyond. Home ignitions and, thus, the WUI fire loss problem principally depend on home ignitability.

*Hose Lay*: Arrangement of connected lengths of fire hose and accessories on the ground, beginning at the first pumping unit and ending at the point of water delivery.

*Hotshot Crew*: A highly trained fire crew used mainly to build fireline by hand.

*Hotspot*: A particular active part of a fire.

*Hotspotting*: Reducing or stopping the spread of fire at points of particularly rapid rate of spread or special threat, generally the first step in prompt control, with emphasis on first priorities.

**I**

*Incendiary*: Causing or capable of causing fire.

*Incident*: A human-caused or natural occurrence, such as wildland fire, that requires emergency service action to prevent or reduce the loss of life or damage to property or natural resources.

*Incident Action Plan (IAP)*: Contains objectives reflecting the overall incident strategy and specific tactical actions and supporting information for the next operational period. The plan may be oral or written. When written, the plan may have a number of attachments, including: incident objectives, organization assignment list, division assignment, incident radio communication plan, medical plan, traffic plan, safety plan, and incident map.

*Incident Command Post (ICP)*: Location at which primary command functions are executed. The ICP may be co-located with the incident base or other incident facilities.

*Incident Command System (ICS)*: The combination of facilities, equipment, personnel, procedure and communications operating within a common organizational structure, with responsibility for the management of assigned resources to effectively accomplish stated objectives pertaining to an incident.

*Incident Commander*: Individual responsible for the management of all incident operations at the incident site.

*Incident Management Team*: The incident commander and appropriate general or command staff personnel assigned to manage an incident.

*Incident Objectives*: Statements of guidance and direction necessary for selection of appropriate strategy(ies), and the tactical direction of resources. Incident objectives are based on realistic expectations of what can be accomplished when all allocated resources have been effectively deployed.

*Indigenous Knowledge*: Knowledge of a particular region or environment from an individual or group that lives in that particular region or environment, e.g., traditional ecological knowledge of American Indians (FS National Resource Book on American Indian and Alaskan Native Relations, 1997).

*Infrared Detection*: The use of heat sensing equipment, known as Infrared Scanners, for detection of heat sources that are not visually detectable by the normal surveillance methods of either ground or air patrols.

*Initial Attack*: The actions taken by the first resources to arrive at a wildfire to protect lives and property, and prevent further extension of the fire.

**J**

*Job Hazard Analysis*: This analysis of a project is completed by staff to identify hazards to employees and the public. It identifies hazards, corrective actions and the required safety equipment to ensure public and employee safety.

*Jump Spot*: Selected landing area for smokejumpers.

*Jump Suit*: Approved protection suite work by smokejumpers.

**K**

*Keech Byram Drought Index (KBDI)*: Commonly used drought index adapted for fire management applications, with a numerical range from 0 (no moisture deficiency) to 800 (maximum drought).

*Knock Down*: To reduce the flame or heat on the more vigorously burning parts of a fire edge.

**L**

*Ladder Fuels*: Fuels that provide vertical continuity between strata, thereby allowing fire to carry from surface fuels into the crowns of trees or shrubs with relative ease. They help initiate and assure the continuation of crowning.

*Large Fire*: (1) For statistical purposes, a fire burning more than a specified area of land, for example, 300 acres. (2) A fire burning with a size and intensity such that its behavior is determined by interaction between its own convection column and weather conditions above the surface.

*Lead Plane*: Aircraft with pilot used to make dry runs over the target area to check wing and smoke conditions and topography and to lead air tankers to targets and supervise their drops.

*Light (Fine) Fuels*: Fast-drying fuels, generally with a comparatively high surface area-to-volume ratio, which are less than 1/4-inch in diameter and have a timelag of one hour or less. These fuels readily ignite and are rapidly consumed by fire when dry.

*Lightning Activity Level (LAL)*: A number on a scale of 1 to 6 that reflects frequency and character of cloud-to ground lightning. The scale is exponential, based on powers of 2 (i.e., LAL 3 indicates twice the lightning of LAL 2).

*Line Scout*: A firefighter who determines the location of a fire line.

*Litter*: Top layer of the forest, scrubland, or grassland floor, directly above the fermentation layer, composed of loose debris of dead sticks, branches, twigs, and recently fallen leaves or needles, little altered in structure by decomposition.

*Live Fuels*: Living plants, such as trees, grasses, and shrubs, in which the seasonal moisture content cycle is controlled largely by internal physiological mechanisms, rather than by external weather influences.

**M**

*Micro-Remote Environmental Monitoring System (Micro-REMS)*: Mobile weather monitoring station. A Micro-REMS usually accompanies an incident meteorologist and ATMU to an incident.

*Mineral Soil*: Soil layers below the predominantly organic horizons; soil with little combustible material.

*Mobilization*: The process and procedures used by all organizations, federal, state and local for activating, assembling, and transporting all resources that have been requested to respond to or support an incident.

*Modular Airborne Firefighting System (MAFFS)*: A manufactured unit consisting of five interconnecting tanks, a control pallet, and a nozzle pallet, with a capacity of 3,000 gallons, designed to be rapidly mounted inside an unmodified C-130 (Hercules) cargo aircraft for use in dropping retardant on wildland fires.

*Mop-up*: To make a fire safe or reduce residual smoke after the fire has been controlled by extinguishing or removing burning material along or near the control line, felling snags, or moving logs so they won't roll downhill.

*Multiagency Coordination (MAC)*: A generalized term that describes the functions and activities of representatives of involved agencies and/or jurisdictions who come together to make decisions regarding the prioritizing of incidents and the sharing and use of critical resources. The MAC organization is not a part of the on-scene ICS and is not involved in developing incident strategy or tactics.

*Mutual Aid Agreement*: Written agreement between agencies and/or jurisdictions in which they agree to assist one another upon request, by furnishing personnel and equipment.

**N**

*National Environmental Policy Act (NEPA)*: NEPA is the basic national law for protection of the environment, passed by Congress in 1969. It sets policy and procedures for environmental protection, and authorizes Environmental Impact Statements and Environmental Assessments to be used as analytical tools to help federal managers make decisions.

*National Fire Danger Rating System (NFDRS)*: A uniform fire danger rating system that focuses on the environmental factors that control the moisture content of fuels.

*National Wildfire Coordinating Group (NWCG)*: A group formed under the direction of the Secretaries of Agriculture and the Interior and comprised of representatives of the US Forest Service, Bureau of Land Management, Bureau of Indian Affairs, National Park Service, US Fish and Wildlife Service, and Association of State Foresters. The group's purpose is to facilitate coordination and effectiveness of wildland fire activities and provide a forum to discuss, recommend action, or resolve issues and problems of substantive nature. NWCG is the certifying body for all courses in the National Fire Curriculum.

*Nomex*: Trade name for a fire-resistant synthetic material used in the manufacturing of flight suits and pants and shirts used by firefighters. (see Aramid)

*Normal Fire Season*: (1) A season when weather, fire danger, and number and distribution of fires are about average. (2) Period of the year that normally comprises the fire season.

**O**

*Operations Branch Director*: Person under the direction of the operations section chief who is responsible for implementing that portion of the incident action plan appropriate to the branch.

*Operational Period*: The period of time scheduled for execution of a given set of tactical actions as specified in the Incident Action Plan. Operational periods can be of various lengths, although usually not more than 24 hours.

*Overhead*: People assigned to supervisory positions, including incident commanders, command staff, general staff, directors, supervisors, and unit leaders.

**P**

*Pack Test*: Used to determine the aerobic capacity of fire suppression and support personnel and assign physical fitness scores. The test consists of walking a specified distance, with or without a weighted pack, in a predetermined period of time, with altitude corrections.

*Paracargo*: Anything dropped, or intended for dropping, from an aircraft by parachute, by other retarding devices, or by free fall.

*Peak Fire Season*: That period of the fire season during which fires are expected to ignite most readily, to burn with greater than average intensity, and to create damages at an unacceptable level.

*Performance Measures*: A quantitative or qualitative characterization of performance (Government Performance and Results Act of 1993).

*Personal Protective Equipment (PPE)*: All firefighting personnel must be equipped with proper equipment and clothing in order to mitigate the risk of injury from, or exposure to, hazardous conditions encountered while working. PPE includes, but is not limited to, 8-inch-high laced leather boots with lug soles, fire shelter, hard hat with chin strap, goggles, ear plugs, aramid shirts and trousers, leather gloves, and individual first aid kits.

*Preparedness*: Condition or degree of being ready to cope with a potential fire situation.

*Prescribed Fire*: Any fire ignited by management actions under certain, predetermined conditions to meet specific objectives related to hazardous fuels or habitat improvement. A written, approved prescribed fire plan must exist, and NEPA requirements must be met, prior to ignition.

*Prescribed Fire Plan (Burn Plan)*: This document provides the prescribed fire burn boss information needed to implement an individual prescribed fire project.

*Prescription*: Measurable criteria that define conditions under which a prescribed fire may be ignited, guide selection of appropriate management responses, and indicate other required actions. Prescription criteria may include safety, economic, public health, environmental, geographic, administrative, social, or legal considerations.

*Prevention*: Activities directed at reducing the incidence of fires, including public education, law enforcement, personal contact, and reduction of fuel hazards.

*Project Fire*: A fire of such size or complexity that a large organization and prolonged activity is required to suppress it.

*Pulaski*: A combination chopping and trenching tool, which combines a single-bitted axe-blade with a narrow adze-like trenching blade fitted to a straight handle. Useful for grubbing or trenching in duff and matted roots. Well-balanced for chopping.

**R**

*Radiant Burn*: A burn received from a radiant heat source.

*Radiant Heat Flux*: The amount of heat flowing through a given area in a given time, usually expressed as calories/square centimeter/second.

*Rappelling*: Technique of landing specifically trained firefighters from hovering helicopters; involves sliding down ropes with the aid of friction-producing devices.

*Rate of Spread*: The relative activity of a fire in extending its horizontal dimensions. It is expressed as a rate of increase of the total perimeter of the fire, as rate of forward spread of the fire front, or as rate of increase in area, depending on the intended use of the information. Usually it is expressed in chains or acres per hour for a specific period in the fire's history.

*Reburn*: The burning of an area that has been previously burned but that contains flammable fuel that ignites when burning conditions are more favorable; an area that has reburned.

*Red Card*: Fire qualification card issued to fire rated persons showing their training needs and their qualifications to fill specified fire suppression and support positions in a large fire suppression or incident organization.

*Red Flag Warning*: Term used by fire weather forecasters to alert forecast users to an ongoing or imminent critical fire weather pattern.

*Rehabilitation*: The activities necessary to repair damage or disturbance caused by wildland fires or the fire suppression activity.

*Relative Humidity (Rh)*: The ratio of the amount of moisture in the air, to the maximum amount of moisture that air would contain if it were saturated. The ratio of the actual vapor pressure to the saturated vapor pressure.

*Remote Automatic Weather Station (RAWS)*: An apparatus that automatically acquires, processes, and stores local weather data for later transmission to the GOES Satellite, from which the data is re-transmitted to an earth-receiving station for use in the National Fire Danger Rating System.

*Resiliency*: The capacity of an ecosystem to maintain or regain normal function and development following disturbance (Society of American Foresters, 1998).

*Resources*: (1) Personnel, equipment, services and supplies available, or potentially available, for assignment to incidents. (2) The natural resources of an area, such as timber, grass, watershed values, recreation values, and wildlife habitat.

*Resource Management Plan (RMP)*: A document prepared by field office staff with public participation and approved by field office managers that provides general guidance and direction for land management activities at a field office. The RMP identifies the need for fire in a particular area and for a specific benefit.

*Resource Order*: An order placed for firefighting or support resources.

*Response Time*: The amount of time it takes from when a request for help is received by the emergency dispatch system until emergency personnel arrive at the scene.

*Retardant*: A substance or chemical agent that reduces the flammability of combustibles.

*Restoration*: The active or passive management of an ecosystem or habitat toward its original structure, natural compliment of species, and natural functions or ecological processes (Cohesive Strategy, 2000).

*Run (of a fire)*: The rapid advance of the head of a fire with a marked change in fire line intensity and rate of spread from that noted before and after the advance.

*Running*: A rapidly spreading surface fire with a well-defined head.

*Rural Fire Assistance*: The Department of the Interior Rural Fire Assistance program is a multi-million dollar program to enhance the fire protection capabilities of rural fire districts. The program will assist with training, equipment purchase, and prevention activities, on a cost-share basis.

**S**

*Safety Zone*: An area cleared of flammable materials used for escape in the event the line is outflanked or in case a spot fire causes fuels outside the control line to render the line unsafe. In firing operations, crews progress so as to maintain a safety zone close at hand allowing the fuels inside the control line to be consumed before going ahead. Safety zones may also be constructed as integral parts of fuel breaks; they are greatly enlarged areas, which can be used with relative safety by firefighters and their equipment in the event of a blow-up in the vicinity.

*Scratch Line*: An unfinished preliminary fire line hastily established or built as an emergency measure to check the spread of fire.

*Severe Wildland Fire (catastrophic wildfire)*: Fire that burns more intensely than the natural or historical range of variability, thereby fundamentally changing the ecosystem, destroying communities and / or rate or threatened species /habitat, or causing unacceptable erosion (GAO / T-RCED-99-79) (Society of American Foresters, 1998).

*Severity Funding*: Funds provided to increase wildland fire suppression response capability necessitated by abnormal weather patterns, extended drought, or other events causing abnormal increase in the fire potential and/or danger.

*Single Resource*: An individual, a piece of equipment and its personnel complement, or a crew or team of individuals with an identified work supervisor that can be used on an incident.

*Size-up*: To evaluate a fire to determine a course of action for fire suppression.

*Slash*: Debris left after logging, pruning, thinning or brush cutting; includes logs, chips, bark, branches, stumps and broken understory trees or brush.

*Sling Load*: Any cargo carried beneath a helicopter and attached by a lead line and swivel.

*Slop-over*: A fire edge that crosses a control line or natural barrier intended to contain the fire.

*Slurry*: A mixture typically of water, red clay, and fertilizer dropped from air tankers for fire suppression.

*Smokejumper*: A firefighter who travels to fires by aircraft and parachute.

*Smoke Management*: Application of fire intensities and meteorological processes to minimize degradation of air quality during prescribed fires.

*Smoldering Fire*: A fire burning without flame and barely spreading.

*Snag*: A standing dead tree or part of a dead tree from which at least the smaller branches have fallen.

*Spark Arrester*: A device installed in a chimney, flue, or exhaust pipe to stop the emission of sparks and burning fragments.

*Spot Fire*: A fire ignited outside the perimeter of the main fire by flying sparks or embers.

*Spot Weather Forecast*: A special forecast issued to fit the time, topography, and weather of each specific fire. These forecasts are issued upon request of the user agency and are more detailed, timely, and specific than zone forecasts.

*Spotter*: In smokejumping, the person responsible for selecting drop targets and supervising all aspects of dropping smokejumpers.

*Spotting*: Behavior of a fire producing sparks or embers that are carried by the wind and start new fires beyond the zone of direct ignition by the main fire.

*Staging Area*: Locations set up at an incident where resources can be placed while awaiting a tactical assignment on a three-minute available basis. Staging areas are managed by the operations section.

*Strategy*: The science and art of command as applied to the overall planning and conduct of an incident.

*Strike Team*: Specified combinations of the same kind and type of resources, with common communications, and a leader.

*Strike Team Leader*: Person responsible to a division/group supervisor for performing tactical assignments given to the strike team.

*Structure Fire*: Fire originating in and burning any part or all of any building, shelter, or other structure.

*Suppressant*: An agent, such as water or foam, used to extinguish the flaming and glowing phases of combustion when direction applied to burning fuels.

*Suppression*: All the work of extinguishing or containing a fire, beginning with its discovery.

*Surface Fuels*: Loose surface litter on the soil surface, normally consisting of fallen leaves or needles, twigs, bark, cones, and small branches that have not yet decayed enough to lose their identity; also grasses, forbs, low and medium shrubs, tree seedlings, heavier branchwood, downed logs, and stumps interspersed with or partially replacing the litter.

*Survivable Space*: The distance between vegetational fuels and a structure necessary to protect the building from radiant heat and its ignition mechanics. The separation distance was formerly called “defensible space” due to the implication that the fire department could intervene. The term “survivable space” eliminates the dependence on manual suppression and implies that the distance alone provides the protection. (see Defensible Space)

*Swamper*: (1) A worker who assists fallers and/or sawyers by clearing away brush, limbs and small trees. Carries fuel, oil and tools and watches for dangerous situations. (2) A worker on a dozer crew who pulls winch line, helps maintain equipment, etc., to speed suppression work on a fire.

**T**

*Tactics*: Deploying and directing resources on an incident to accomplish the objectives designated by strategy.

*Tanker*: Either a tank truck used to deliver water from a water source to the scene of a fire, or a fixed wing aircraft used for fire suppression by dropping slurry on the flank or head of a fire.

*Temporary Flight Restrictions (TFR)*: A restriction requested by an agency and put into effect by the Federal Aviation Administration in the vicinity of an incident that restricts the operation of nonessential aircraft in the airspace around that incident.

*Terra Torch*: Device for throwing a stream of flaming liquid, used to facilitate rapid ignition during burn out operations on a wildland fire or during a prescribed fire operation.

*Test Fire*: A small fire ignited within the planned burn unit to determine the characteristic of the prescribed fire, such as fire behavior, detection performance and control measures.

*Timelag*: Time needed under specified conditions for a fuel particle to lose about 63 percent of the difference between its initial moisture content and its equilibrium moisture content. If conditions remain unchanged, a fuel will reach 95 percent of its equilibrium moisture content after four timelag periods.

*Torching*: The ignition and flare-up of a tree or small group of trees, usually from bottom to top.

*Two-way Radio*: Radio equipment with transmitters in mobile units on the same frequency as the base station, permitting conversation in two directions using the same frequency in turn.

*Type*: The capability of a firefighting resource in comparison to another type. Type 1 usually means a greater capability due to power, size, or capacity.

**U**

*Uncontrolled Fire*: Any fire that threatens to destroy life, property, or natural resources and (a) is not burning within the confines of firebreaks or (b) is burning with such intensity that it could not be readily extinguished with ordinary tools commonly available [Parts a and b of definition added from the National Wildfire Coordinating Group's *Glossary of Wildland Fire Terminology*, http://www.nwcg.gov/pms/pubs/glossary]. (see Wildfire)

*Underburn*: A fire that consumes surface fuels but not trees or shrubs. (see Surface Fuels)

*Unplanned and Unwanted Wildland Fires*: An unplanned and unwanted fire is one burning outside the parameters as defined in land use plans and fire management plans for that location (including areas where the fire can be expected to spread) under current and expected conditions. Unplanned and unwanted fires include fires burning in areas where fire is specifically excluded; fires that exhibit burning characteristics (intensity, frequency, and seasonality) that are outside prescribed ranges, specifically including fires expected to produce severe fire effects; unauthorized human caused fires (arson, escaped camp fires, equipment fires, etc.); and fires that occur during high fire dangers, or resource shortage, where the resources needed to manage the fire are needed for more critical fire management needs. Unplanned is not the same as unscheduled. The time of a lightning fire ignition is not known; however, a lightning-caused fire could still be used to meet fuels and ecosystem management objectives if that type of fire is expected to burn within the parameters of an approved plan; the fire is burning within the parameters for the area; is not causing, or has the potential to cause, unacceptable effects; and funding and resources to manage the fire are available.

**V**

*Vectors*: Directions of fire spread as related to rate of spread calculations (in degrees from upslope).

*Volunteer Fire Department (VFD)*: A fire department of which some or all members are unpaid.

**W**

*Water Tender*: A ground vehicle capable of transporting specified quantities of water.

*Weather Information and Management System (WIMS)*: An interactive computer system designed to accommodate the weather information needs of all federal and state natural resource management agencies. Provides timely access to weather forecasts, current and historical weather data, the National Fire Danger Rating System (NFDRS), and the National Interagency Fire Management Integrated Database (NIFMID).

*Wet Line*: A line of water, or water and chemical retardant, sprayed along the ground, that serves as a temporary control line from which to ignite or stop a low-intensity fire.

*Wildfire*: An unplanned, unwanted wildland fire including unauthorized human-caused fires, escaped wildland fire use events, escaped prescribed fire projects, and all other wildland fire where the objective is to put the fire out [definition added from the National Wildfire Coordinating Group's *Glossary of Wildland Fire Terminology*, http://www.nwcg.gov/pms/pubs/glossary]. (see Uncontrolled Fire; Wildland Fire)

*Wildland*: Wildland is an area of land where plants and animals exist free of human interference. Ecologists assert that wildlands promote biodiversity, that they preserve historic genetic traits and that they provide habitat for wild flora and fauna [definition added from Wikipedia, http://en.wikipedia.org/wiki/Wildland].

*Wildland Fire*: Any nonstructure fire, other than prescribed fire, that occurs in the wildland.

*Wildland Fire Implementation Plan (WFIP)*: A progressively developed assessment and operational management plan that documents the analysis and selection of strategies and describes the appropriate management response for a wildland fire being managed for resource benefits.

*Wildland Fire Situation Analysis (WFSA)*: A decision-making process that evaluates alternative suppression strategies against selected environmental, social, political, and economic criteria. Provides a record of decisions.

*Wildland Fire Use*: The management of naturally ignited wildland fires to accomplish specific, planned resource management objectives in predefined geographic areas outlined in Fire Management Plans. Wildland fire use is not to be confused with "fire use," which includes prescribed fire.

*Wildland Urban Interface (WUI)*: The line, area or zone where structures and other human development meet or intermingle with undeveloped wildland or vegetative fuels (Glossary of Wildland Fire Terminology, 1996).

*Wind Vectors*: Wind directions used to calculate fire behavior.

# APPENDIX A. DESCRIPTIONS OF VEGETATION ASSOCIATIONS

The following vegetation information from the *Southwest Regional GAP Analysis Project—Land Cover Data Legend Descriptions* (USGS 2005) was used to analyze vegetation associations composing the WUI of the Pinal County CWPP. For additional information, see the Southwest Regional Landcover Data Web site (http://ftp.nr.usu.edu/swgap/landcover.html).

## DESERT SHRUB-SCRUB ASSOCIATIONS

### S070 Sonora-Mohave Mixed Salt Desert Scrub

**Concept Summary:** This system includes extensive open-canopied shrublands of typically saline basins in the Mojave and Sonoran deserts. Stands often occur around playas. Substrates are generally fine-textured, saline soils. Vegetation is typically composed of one or more *Atriplex* species such as *Atriplex canescens* or *Atriplex polycarpa* along with other species of *Atriplex*. Species of *Allenrolfea, Salicornia, Suaeda*, or other halophytic plants are often present to codominant. Graminoid species may include *Sporobolus airoides* or *Distichlis spicata* at varying densities.

### S129 Sonoran Mid-elevation Desert Scrub

**Concept Summary:** This transitional desert scrub system occurs along the northern edge of the Sonoran Desert in an elevational band along the lower slopes of the Mogollon Rim/Central Highlands region between 750–1,300 m. Stands occur in the Bradshaw, Hualapai, and Superstition mountains among other desert ranges and are found above Sonoran Paloverde-Mixed Cacti Desert Scrub (CES302.761) and below Mogollon Chaparral (CES302.741). Sites range from a narrow strip on steep slopes to very broad areas such as the Verde Valley. Climate is too dry for chaparral species to be abundant, and freezing temperatures during winter are too frequent and prolonged for many of the frost-sensitive species that are characteristic of the Paloverde Mixed-Cacti Desert Scrub such as *Carnegiea gigantea, Parkinsonia microphylla, Prosopis* spp., *Olneya tesota*, *Ferocactus* sp. and *Opuntia bigelovii*. Substrates are generally rocky soils derived from parent materials such as limestone, granitic rocks or rhyolite. The vegetation is typically composed of an open shrub layer of *Larrea tridentata, Ericameria linearifolia*, or *Eriogonum fasciculatum* with taller shrub such as *Fourqueria splendens*, *Canotia holacantha* (limestone or granite) or *Simmondsia chinensis* (rhyolite). The herbaceous layer is generally sparse.

### S063 Sonoran Paloverde-Mixed Cacti Desert Scrub

**Concept Summary:** This ecological system occurs on hillsides, mesas and upper bajadas in southern Arizona and extreme southeastern California. The vegetation is characterized by a diagnostic sparse, emergent tree layer of *Carnegiea gigantea* (3–16 m tall) and/or a sparse to moderately dense canopy codominated by xeromorphic deciduous and evergreen tall shrubs *Parkinsonia microphylla* and *Larrea tridentata* with *Prosopis* sp., *Olneya tesota*, and *Fouquieria splendens* less prominent. Other common shrubs and dwarf-shrubs include *Acacia greggii*, *Ambrosia deltoidea*, *Ambrosia dumosa* (in drier sites),

*Calliandra eriophylla, Jatropha cardiophylla, Krameria erecta, Lycium* spp., *Menodora scabra, Simmondsia chinensis*, and many cacti including *Ferocactus* spp., *Echinocereus* spp., and *Opuntia* spp. (both cholla and prickly pear). The sparse herbaceous layer is composed of perennial grasses and forbs with annuals seasonally present and occasionally abundant. On slopes, plants are often distributed in patches around rock outcrops where suitable habitat is present.

**S062 Chihuahuan Creosotebush, Mixed Desert And Thorn Scrub**

**Concept Summary:** This widespread Chihuahuan Desert land cover type is composed of two ecological systems the Chihuahuan Creosotebush Xeric Basin Desert Scrub (CES302.731) and the Chihuahuan Mixed Desert and Thorn Scrub (CES302.734 ). This cover type includes xeric creosotebush basins and plains and the mixed desert scrub in the foothill transition zone above, sometimes extending up to the lower montane woodlands. Vegetation is characterized by *Larrea tridentata* alone or mixed with thornscrub and other desert scrub such as *Agave lechuguilla, Aloysia wrightii, Fouquieria splendens, Dasylirion leiophyllum, Flourensia cernua, Leucophyllum minus, Mimosa aculeaticarpa var. biuncifera, Mortonia scabrella (= Mortonia sempervirens* ssp. *scabrella), Opuntia engelmannii, Parthenium incanum, Prosopis glandulosa*, and *Tiquilia greggii*. Stands of *Acacia constricta Acacia neovernicosa* or *Acacia greggii* dominated thornscrub are included in this system, and limestone substrates appear important for at least these species. Grasses such as *Dasyochloa pulchella, Bouteloua curtipendula, Bouteloua eriopoda, Bouteloua ramosa*, *Muhlenbergia porteri* and *Pleuraphis mutica* may be common, but generally have lower cover than shrubs.

**S116 Chihuahuan Mixed Salt Desert Scrub**

**Concept Summary:** This system includes extensive open-canopied shrublands of typically saline basins in the Chihuahuan Desert. Stands often occur on alluvial flats and around playas. Substrates are generally fine-textured, saline soils. Vegetation is typically composed of one or more *Atriplex* species such as *Atriplex canescens, Atriplex obovata*, or *Atriplex polycarpa* along with species of *Allenrolfea, Flourensia, Salicornia, Suaeda*, or other halophytic plants. Graminoid species may include *Sporobolus airoides, Pleuraphis mutica*, or *Distichlis spicata* at varying densities.

**S069 Sonoran Mohave Creosotebush-White Bursage Desert Scrub**

**Concept Summary:** This ecological system forms the vegetation matrix in broad valleys, lower bajadas, plains and low hills in the Mojave and lower Sonoran deserts. This desert scrub is characterized by a sparse to moderately dense layer (2%–50% cover) of xeromorphic microphyllous and broad-leaved shrubs. *Larrea tridentata* and *Ambrosia dumosa* are typically dominants, but many different shrubs, dwarf-shrubs, and cacti may codominate or form typically sparse understories. Associated species may include *Atriplex canescens, Atriplex hymenelytra, Encelia farinosa, Ephedra nevadensis, Fouquieria splendens, Lycium andersonii*, and *Opuntia basilaris*. The herbaceous layer is typically sparse, but may be seasonally

abundant with ephemerals. Herbaceous species such as *Chamaesyce* spp., *Eriogonum inflatum, Dasyochloa pulchella, Aristida* spp., *Cryptantha* spp., *Nama* spp., and *Phacelia* spp. are common.

## SHRUBLANDS VEGETATION ASSOCIATIONS

### S058 Apacherian-Chihuahuan Mesquite Upland Scrub

**Concept Summary:** This ecological system occurs as upland shrublands that are concentrated in the extensive grassland-shrubland transition in foothills and piedmont in the Chihuahuan Desert. It extends into the Sky Island region to the west, and the Edwards Plateau to the east. Substrates are typically derived from alluvium, often gravelly without a well-developed argillic or calcic soil horizon that would limit infiltration and storage of winter precipitation in deeper soil layers. *Prosopis* spp. and other deep-rooted shrubs exploit this deep soil moisture that is unavailable to grasses and cacti. Vegetation is typically dominated by *Prosopis glandulosa* or *Prosopis velutina* and succulents. Other desert scrub that may codominate or dominate includes *Acacia neovernicosa, Acacia constricta, Juniperus monosperma*, or *Juniperus coahuilensis*. Grass cover is typically low. During the last century, the area occupied by this system has increased through conversion of desert grasslands as a result of drought, overgrazing by livestock, and/or decreases in fire frequency. It is similar to Chihuahuan Mixed Desert and Thorn Scrub (CES302.734), but is generally found at higher elevations where *Larrea tridentata* and other desert scrub is not codominant. It is also similar to Chihuahuan Stabilized Coppice Dune and Sand Flat Scrub (CES302.737), but does not occur on eolian-deposited substrates.

## GRASSLANDS VEGETATION ASSOCIATIONS

### S077 Apacherian-Chihuahuan Piedmont Semi-Desert Grassland and Steppe

**Concept Summary:** This ecological system is a broadly defined desert grassland, mixed shrub-succulent or xeromorphic tree savanna that is typical of the Borderlands of Arizona, New Mexico and northern Mexico [Apacherian region], but extends west to the Sonoran Desert, north into the Mogollon Rim and throughout much of the Chihuahuan Desert. It is found on gently sloping bajadas that supported frequent fire throughout the Sky Islands and on mesas and steeper piedmont and foothill slopes in the Chihuahuan Desert. It is characterized by a typically diverse perennial grasses. Common grass species include *Bouteloua eriopoda, B. hirsuta,B. rothrockii, B. curtipendula, B. gracilis, Eragrostis intermedia, Muhlenbergia porteri, Muhlenbergia setifolia, Pleuraphis jamesii, Pleuraphis mutica*, and *Sporobolus airoides*, succulent species of *Agave, Dasylirion*, and *Yucca*, and tall shrub/short tree species of *Prosopis* and various oaks (e.g., *Quercus grisea, Quercus emoryi, Quercus arizonica*). Many of the historical desert grassland and savanna areas have been converted, some to Chihuahuan Mesquite Woodlands Vegetation Associations.

## WOODLANDS VEGETATION ASSOCIATIONS

### S057 Mogollon Chaparral

**Concept Summary:** This ecological system occurs across central Arizona (Mogollon Rim), western New Mexico and southwestern Utah and southeast Nevada. It often dominants along the mid-elevation transition from the Mojave, Sonoran, and northern Chihuahuan deserts into mountains (1,000–2,200 m). It occurs on foothills, mountain slopes and canyons in dryer habitats below the encinal and *Pinus ponderosa* woodlands. Stands are often associated with more xeric and coarse-textured substrates such as limestone, basalt or alluvium, especially in transition areas with more mesic woodlands. The moderate to dense shrub canopy includes species such as *Quercus turbinella, Quercus toumeyi, Cercocarpus montanus, Canotia holacantha, Ceanothus greggii, Forestiera pubescens (= Forestiera neomexicana), Garrya wrightii, Juniperus deppeana, Purshia stansburiana, Rhus ovata, Rhus trilobata*, and *Arctostaphylos pungens* and *Arctostaphylos pringlei* at higher elevations. Most chaparral species are fireadapted, resprouting vigorously after burning or producing fire-resistant seeds. Stands occurring within montane woodlands are seral and a result of recent fires.

### S051 Madrean Encinal

**Concept Summary:** Madrean Encinal occurs on foothills, canyons, bajadas and plateaus in the Sierra Madre Occidentale and Sierra Madre Orientale in Mexico, extending north intoTrans-Pecos Texas, southern New Mexico and sub-Mogollon Arizona. These woodlands are dominated by Madrean evergreen oaks along a low-slope transition below Madrean Pine-Oak Forest and Woodland (CES305.796) and Madrean Pinyon-Juniper Woodland (CES305.797). Lower elevation stands are typically open woodlands or savannas where they transition into desert grasslands, chaparral or is some case desertscrub. Common evergreen oak species include *Quercus arizonica,Quercus emoryi,Quercus intricata, Quercus grisea, Quercus oblongifolia*, *Quercus toumeyi* and in Mexico, *Quercus chihuahuaensis* and *Quercus albocincta*. Madrean pine, Arizona cypress, pinyon and juniper trees may be present, but do not codominate. Chaparral species such as *Arctostaphylos pungens, Cercocarpus montanus, Purshia* spp*. Garrya wrightii, Quercus turbinella, Frangula betulifolia (=Syn Rhamnus betulifolia),* or *Rhus* spp*.* may be present, but do not dominate. The graminoid layer is usually prominent between trees is grassland or steppe that is dominated by warm-season grasses such as *Aristida* spp., *Bouteloua gracilis, Bouteloua curtipendula, Bouteloua rothrockii, Digitaria californica, Eragrostis intermedia, Hilaria belangeri, Leptochloa dubia, Muhlenbergia* spp., *Pleuraphis jamesii*, or *Schizachyrium cirratum;* species typical of Chihuahuan Piedmont Semi-Desert Grassland (CES302.735). This system includes seral stands dominated by shrubby Madrean oaks typically with strong graminoid layer. In transition areas with dryer chaparral systems, stands of chaparral are not dominated by Madrean oaks, however Madrean encinal may extend down along drainages.

## DECIDUOUS SOUTHWEST RIPARIAN ASSOCIATIONS

### S098 North American Warm Desert Riparian Mesquite Bosque

**Concept Summary:** This ecological system consists of low-elevation (<1,100 m) riparian corridors along intermittent streams in valleys of southern Arizona and New Mexico, and adjacent Mexico. Dominant trees include *Prosopis glandulosa* and *Prosopis velutina*. Shrub dominants include *Baccharis salicifolia, Pluchea sericea*, and *Salix exigua*. Vegetation, especially the mesquites, tap groundwater below the streambed when surface flows stop. Vegetation is dependent upon annual rise in the water table for growth and reproduction.

## OTHER COVER TYPES AND NONVEGETATED ASSOCIATIONS: ALTERED, DISTURBED, AND DEVELOPED

### N21 Developed, Open Space—Low Intensity

**Concept Summary:** Open Space: Includes areas with a mixture of some construction materials, but mostly vegetation in the form of lawn grasses. Impervious surfaces account for less than 20 percent of total cover. These areas most commonly include large-lot single-family housing units, parks, golf courses, and vegetation planted in developed settings for recreation, erosion control, or aesthetic purposes. Developed, Low intensity: Includes areas with a mixture of constructed materials and vegetation. Impervious surfaces account for 20–49 percent of total cover. These areas most commonly include single-family housing units.

### N22 Developed, Medium—High Intensity

**Concept Summary:** Developed, Medium Intensity: Includes areas with a mixture of constructed materials and vegetation. Impervious surface accounts for 50–79 percent of the total cover. These areas most commonly include single-family housing units. Developed, High Intensity: Includes highly developed areas where people reside or work in high numbers. Examples include apartment complexes, row houses and commercial/industrial. Impervious surfaces account for 80 to 100 percent of the total cover (NLCD draft legend, July 25, 2003).

### N31 Barren Land Types

**Concept Summary:** (Rock/Sand/Clay)-Barren areas of bedrock, desert pavement, scarps, talus, slides, volcanic material, glacial debris, sand dunes, strip mines, gravel pits and other accumulation of earthen material. Generally, vegetation accounts for less than 15 percent of total cover.

**S010 Colorado Plateau Mixed Bedrock Canyon and Tableland**

**Concept Summary:** The distribution of this ecological system is centered on the Colorado Plateau where it is comprised of barren and sparsely vegetated landscapes (generally <10% plant cover) of steep cliff faces, narrow canyons, and open tablelands of predominantly sedimentary rocks, such as sandstone, shale, and limestone. Some eroding shale layers similar to Inter-Mountain Basins Shale Badland (CES304.789) may be interbedded between the harder rocks. The vegetation is characterized by very open tree canopy or scattered trees and shrubs with a sparse herbaceous layer. Common species includes *Pinus edulis, Pinus ponderosa, Juniperus* spp., *Cercocarpus intricatus*, and other short-shrub and herbaceous species, utilizing moisture from cracks and pockets where soil accumulates.

**S016 North American Warm Desert Bedrock Cliff and Outcrop**

**Concept Summary:** This ecological system is found from subalpine to foothill elevations and includes barren and sparsely vegetated landscapes (generally <10% plant cover) of steep cliff faces, narrow canyons, and smaller rock outcrops of various igneous, sedimentary, and metamorphic bedrock types. Also included are unstable scree and talus slopes that typically occur bellow cliff faces. Species present are diverse and may include *Bursera microphylla, Fouquieria splendens, Nolina bigelovii, Opuntia bigelovii*, and other desert species, especially succulents. Lichens are predominant lifeforms in some areas. May include a variety of desert shrublands less than 2 ha (5 acres) in size from adjacent areas.

**N80 Agriculture**

**Concept Summary:** Agriculture—unable to make distinction between N81 and N82.

**D03—Recently Mined or Quarried**

**Concept Summary:** 2 hectare or greater, open-pit mining or quarries visible on imagery.

# APPENDIX B. NATIONAL FIRE DANGER RATING SYSTEM FUEL MODEL SELECTION KEY

**I. Mosses, lichens, and low shrubs predominate ground fuels**

A. Overstory of conifers occupies more than one-third of the site

*Model Q*

B. No overstory or it occupies less than one-third of the site

*Model S*

**II. Marsh grasses and/or reeds predominate**

*Model N*

**III. Grasses and/or forbs predominate**

A. Open overstory of conifer and/or hardwoods

*Model C*

B. No overstory

1. Woody shrubs occupy more than one-third, but less than two-thirds of the site

*Model T*

2. Woody shrubs occupy less than two-thirds of the site

a. The grasses and forbs are primarily annuals

*Model A*

b. Grasses and forbs are primarily perennials

*Model L*

**IV. Brush, shrubs, tree reproduction, or dwarf tree species predominate**

A. Average height of woody plants is 6 feet or greater

1. Woody plants occupy two-thirds or more of the site

a. One-fourth or more of the woody foliage is dead

1) Mixed California chaparral

*Model B*

2) Other types of brush

*Model F*

b. Up to one-fourth of the woody foliage is dead

*Model Q*

c. Little dead foliage

*Model O*

2. Woody plants occupy less than two-thirds of the site

*Model F*

B. Average height of woody plants is less than 6 feet

1. Woody plants occupy two-thirds or more of the site

a. Western United States

*Model F*

b. Eastern United States

*Model O*

2. Woody plants occupy less than two-thirds but greater than one-third of the site

a. Western United States

*Model T*

b. Eastern United States

*Model D*

3. Woody plants occupy less than one-third of the site

a. Grasses and forbs are primarily annuals

*Model A*

b. Grasses and forbs are primarily perennials

*Model L*

**V. Trees predominate**

A. Deciduous broadleaf species predominate

1. Area has been thinned or partially cut, leaving slash as the major fuel component

*Model K*

2. Area has not been thinned or partially cut

a. Overstory is dormant; leaves have fallen

*Model E*

b. Overstory is in full leaf

*Model R*

B. Conifer species predominate

1. Lichens, mosses, and low shrubs dominate as understory fuels

   *Model Q*

2. Grasses and forbs are the primary ground fuel

   *Model C*

3. Woody shrubs and/or reproduction dominate as understory fuels

   a. Understory burns readily

      1) Western United States

         *Model T*

      2) Eastern United States

         a) Understory is more than 6 feet tall

            *Model O*

         b) Understory is less than 6 feet tall

            *Model D*

   b. Understory seldom burns

      *Model H*

4. Duff and litter, branch wood, and tree boles are the primary ground fuel

   a. Overstory is over mature and decadent; heavy accumulation of dead debris

      *Model G*

   b. Overstory is not decadent; Only a nominal accumulation of debris

      1) Needles are 2 inches or more in length (most pines)

         a) Eastern United States

            *Model P*

         b) Western United States

            *Model U*

      2) Needles are less than 2 inches long

         *Model H*

**VI. Slash is predominant fuel type**

A. Foliage is still attached; little settling

1. Loading is 25 tons/acre or greater

   *Model I*

2. Loading is less than 25 tons/acre but greater than 15 tons/acre

   *Model J*

3. Loading is less than 15 tons/acre

   *Model K*

B. Settling is evident; foliage is falling off; grasses, forbs and shrubs are invading

1. Loading is 25 tons/acre or greater

   *Model J*

2. Loading is less than 25 tons/acre

   *Model K*

# APPENDIX C. EDUCATIONAL RESOURCES

## Firewise Information and Web Sites

Firewise Communities/USA national recognition program. http://www/Firewise.org/USA.

The FireFree Program, sponsored by SAFECO Corporation, Wildfire Defense Get in the Zone, Reduce Your Risk of Wildfire pamphlet. http://www.Safeco.com/Safeco/about/giving/firefree.org.

Living with Fire—A Homeowners' Guide. A 12-page tabloid, which is produced regionally by US Department of Interior agencies (Bureau of Indian Affairs, Bureau of Land Management, Fish and Wildlife Service, National Park Service), the USDA Forest Service, and state land departments. This is one of the most detailed pieces of Firewise information for landowners to reference when creating survivable space around their homes. http://www.or.blm.gov/nwfire/docs/Livingwithfire.pdf.

Fire Information Clearinghouse, San Juan Public Lands Center.
http://www.SouthwestColoradoFires.org.

## Best Management Practices and Tools for Collaboration

The Collaboration Handbook, Red Lodge Clearinghouse. http://www.rlch.org/content/view/261/49.

Ecosystem management Initiative at the University of Michigan.
http://wwwsnre.umich.edu/ecomgt.collaboration.htm.

Western Collaborative Assistance Network. http://www.westcanhelp.org.

BLM Partnership. http://www.blm.gov/partnerships/tools.htm.

Forest Service Partnership Resource Center. http://www.partnershipresourcescenter, org/index.shtml.

International Association of Fire Chief's Leader's guide for Developing a Community Wildfire Protection Plan. http://wwwcsfs.colostate.edu/librar/.pdfs/cwpp/CWPP_LG.pdf.

Joint Fire Sciences Collaboration and CWPP Presentation. http://www.jfsp.fortlewis.edu/KTWorkshops.asp.

## Grant Web Sites

Southwest Area Forest, Fire, and Community Assistance Grants. This Web site lists grants that are available to communities to reduce the risk of wildfires in the urban interface. http://www.SouthwestAreaGrants.org.

Department of Homeland Security Web site for granting opportunities for Staffing for Adequate Fire and Emergency Services (SAFER) grants and provides other useful information. http://www.firegrantsupport.com.

ESRI Grant Assistance program for GIS users. http://www.esri.com/grants.

US Fire Administration—Assistance to Firefighters Grant Program. http://www.usfa.fema.gove/dhtml/inside-usfa/grants.cfm.

National Association of State Foresters Listing of Grant Sources and Appropriations. http://www/stateforesters.org/S&PF/FY_2002.html.

Stewardship and Landowner Assistance—Financial Assistance Programs. http://www.na.fs.fed.us/spfo/stewardship/financial.htm.

The Fire Safe Council. http://www.FireSafeCouncil.org.

Pre-disaster Mitigation Program. http://www/cfda/gov/public/viewprog.asp?progid=1606.

Firewise. http://www.firewise.org/usa/funding.htm.

Environmental Protection Agency. http://cfpub.epa.gov/fedfund.

Rural Fire Assistance and other State Forestry Grants. http://www.azsf.az.gov/grant_information.

Grant opportunities. http://www.grants.gov.

**Arizona Wildfire and the Environment Series**

Firewise publications from the University of Arizona: Forest Home Fire Safety; Fire-Resistant Landscaping; Creating Wildfire-Defensible Spaces for Your Home and Property; Homeowners' "Inside and Out" Wildfire Checklist; Firewise Plant Materials for 3000 Feet and Higher Elevations; Soil Erosion Control After a Wildfire; Recovering from Wildfire; A Guide for Arizona's Forest Owners; Wildfire Hazard Severity Rating Checklist for Arizona Homes and Communities. http://cals.arizona.edu; http://cals.arizona.edu/pubs.

**Monitoring and Evaluation Resources**

USDA Forest Service Collaborative Restoration Program—Multiparty Monitoring Guidelines. http://www.fs.fed.us/r3/spf/cfrp/monitoring/index.shtml.

Rural Voices for Conservation Coalition – Multiparty Monitoring Issue Paper. http://www.ri.uoregon.edu/programs/CCE/communityfireplanning.html.

**Other**

Federal Emergency Management Agency (FEMA) State Hazard Mitigation Offices. http://www.floods.org/shmos.htm.

National Fire Plan. http://www.fireplan.gov/community_assist.crm.

National Fire Protection Association (NFPA) NFPA 299 (Standard for Protection of Life and Property from Wildfire); NFPA 295 (Standard for Wildfire Control); NFPA 291 (Recommended Practice for Fire Flow Testing and Marking of Hydrants); NFPA 703 (Standard for Fire Retardant Impregnated Coatings for Building Materials); NFPA 909 (Protection of Cultural Resources); NFPA 1051 (Standard for Wildland Fire

Fighter Professional Qualifications); NFPA 1144 (Standard for Protection of Life and Property from Wildfire); NFPA 1977 (Standard on Protective Clothing and Equipment for Wildland Fire Fighting). http://www.nfpa.org; http://www.nfpa.org/Catalog.

National Fire Lab. http://www.firelab.org/fbp/fbresearch/WUI/home.htm.

Protect Your Home from Wildfire. Publications to help assist you with wildfire prevention. Colorado State Forest Service. http://www.colostate.edu/Depts/CSFS/homefire.html.

US Fire Administration, FEMA, US Department of Homeland Security. http://www.usfa.fema.gov; http://www.fema.gov/regions/viii/fires/shtm; http://www.fema.gov/kidswldfire.

Fire Education Materials. http://www.symbols.gov.

National Interagency Fire Center, National Park Service fire site. http://www.nifc.nps.gov/fire.

PBS NOVA—"Fire Wars." http://www.pbs.org/wgbh/nova/fire.

D'Goat Ranch, LLC. Jason Garn. (801) 440-2149. Leasing and goat herding for vegetative mitigation projects.

Woody Biomass Utilization Desk Guide.
http://www.forestsandrangelands.gov/woody_biomass/documents/biomass_deskguide.pdf.

**Pamphlets**

Saving Homes from Wildfires: Regulating the Home Ignition Zone, by the American Planning Association (APA).

This May 2001 issue of the APA's Zoning News examines the wildfire threat to the wildland urban interface zone and shows how development codes can be used to save residential areas.

**Books**

Everyone's Responsibility: Fire Protection in the Wildland Urban Interface, NFPA, 1994. This National Fire Protection Association book shows how three communities dealt with interface problems.

Firewise Construction Design and Materials Publication, sponsored by the Colorado State Forest Service (CSFS) and the Federal Emergency Management Agency (FEMA). This booklet is 38 pages of detailed home construction ideas to make a home Firewise. Various other publications are available from the CSFS on wildland urban interface issues.

Is Your Home Protected from Wildfire Disaster? A Homeowner's Guide to Wildfire Retrofit, IBHS, 2001. This Institute for Business and Home Safety book provides homeowners with guidance on ways to retrofit and build homes to reduce losses from wildfire damage.

Stephen Bridge, Road Fire Case Study, NFPA, 1991. Provides information to assist planners, local officials, fire service personnel, and homeowners.

Wildland Fire—Communicator's Guide. This is a guide for fire personnel, teachers, community leaders, and media representatives.

### CD ROMs

Arizona Firewise Communities Educator's Workshop, Payson, AZ, February 18–19, 2003.

Burning Issues, Florida State University and the USDI Bureau of Land Management, 2000. Interactive multimedia program for middle and high school students to learn about the role of fire in the ecosystems and the use of fire managing rural areas.

Wildland Fire Communicator's Guide. This interactive CD-ROM compliments the book.

### Other Publications

It Can't Happen to My Home! Are You Sure? A publication by the USDA Forest Service, Southwestern Region, 12 page document.

Wildfire Strikes Home! It Could Happen to You, How to Protect Your Home! / Homeowners Handbook, from the USDI Bureau of Land Management, the USDA Forest Service and state foresters (publication nos. NFES 92075 and NFES 92074).

# APPENDIX D. INFORMATION DATA SHEET AND CONTACTS

## D.1. CWPP Base Information Data Source

| Name | Type | Source | Contact / Web address |
|---|---|---|---|
| Wildland Fuel Hazards | Shapefile | Logan Simpson Design Inc. | Rob Cox (480) 967-1343; rcox@lsdaz.com |
| Wildland-Urban Interface (WUI) | Shapefile | Logan Simpson Design Inc. | Rob Cox (480) 967-1343; rcox@lsdaz.com |
| Vegetation Zones | Raster | Southwest Regional Gap Analysis Project (USGS 2005) | http://earth.gis.usu.edu/swgap/ |
| Well Locations | Shapefile | ADWR | ADWR<br>602-771-8638<br>mxb@azwater.gov |
| Land Ownership | Shapefile | Arizona State Land Department | Land Resources Information System<br>Published 20071029 |
| Ignition History | Shapefile | Bureau of Land Management | http://wildfire.cr.usgs.gov/firehistory/ |

All final-analysis GIS data, including flammability analysis, fuel hazards analysis, ignition history and density, community values analysis, cumulative risk analysis, treatment management units, and areas of elevated concern are located at the Pinal County Office of Emergency Management and at Logan Simpson Design Inc.

## D.2. Pinal County CWPP Contacts

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# APPENDIX E. INVASIVE SPECIES

The following information is presented by the Core Teams to assist municipal, state, and federal land managers with basic recommendations for the management of invading saltcedar, red brome, cheatgrass, buffelgrass, and Mediterranean grass within Pinal County. Information about invading tree species is from the USDA's online Fire Effects Information System (Zouhar 2003 and Hauser 2008), the *Strategy for Long-Term Management of Exotic Trees in Riparian Areas for New Mexico's Five River Systems, 2005–2014* (USDA FS and New Mexico Energy, Minerals and Natural Resources Department, Forestry Division 2005), and the *San Juan Basin Watershed Management Plan* (San Juan County Watershed Group 2005). Information for red brome, cheatgrass, and bufflegrass is from the USDA's online Fire Effects Information System (Hauser 2008). Additional information is available from *Invasive Non-Native Plants that Threaten Wildlands In Arizona: A Categorized List Developed by the Arizona Wildlands Invasive Plant Working Group* (AZ-WIPWG 2005) and from *Southern Arizona Buffelgrass Strategic Plan* (Buffelgrass Working Group 2008).

## Saltcedar

The continued degradation of native riparian plant communities from invading tree species is a significant concern to the citizens of Pinal County.

Saltcedar is one of the most widely distributed and troublesome nonnative invasive plants along watercourses in the southwestern United Sates. Saltcedar reduces recreational usage of parks, and riparian areas for camping, hunting, fishing, and agriculture. Since its escape from cultivation, saltcedar has spread primarily in the southwestern US and northern Mexico although its distribution extends into many parts of North America. It is especially pervasive in, and has dominated many low areas bordering the channel of the southwest river systems since the 1940s. More than 50 percent of the area covered by floodplain plant communities was dominated by saltcedar by 1970 (<www.fs.fed.us/database/feis/plants>). Saltcedar dominated communities are often monotypic, though cottonwood and willow are common associates. Several studies in Arizona and New Mexico suggest that saltcedar communities do not support as high a density of native bird species as do native plant communities, however saltcedar provides habitat for a number of bird species including white-winged and mourning doves, summer tanager, yellow billed cuckoo and the endangered Southwestern willow flycatcher. Saltcedar communities can trap and stabilize alluvial sediments, reducing the width, depth and water-holding capacity of river channels. This can subsequently increase the frequency and severity of overbank flooding. These stands can have extremely high evapotranspiration rates when water tables are high but not necessarily when water tables are low or under drought conditions. Because saltcedar stands tend to extend beyond the boundaries of native phreatophytes and to develop higher leaf area index, water use by saltcedar on a regional scale might be substantially higher than for other riparian species. While the natural flood disturbance regime seems to promote native species and discourage saltcedar, consistent natural river flow conditions through riparian areas is rarely sustained in the Pinal County CWPP.

There is little quantitative information on prehistoric frequency, seasonality, severity, and spatial extent of fire in North American riparian ecosystems. Fires in low- to mid-elevation southwestern riparian plant communities dominated by cottonwood, willow and/or mesquite are thought to have been infrequent.

Increases in fire size or frequency have been reported for river systems in recent decades. Fire appears to be less common in riparian ecosystems where saltcedar has not invaded. Increases in fire size and frequency are attributed to a number of factors including an increase in ignition sources, increased fire frequency in surrounding uplands, and increased abundance of fuels. The structure of saltcedar stands may be more conducive to repeated fire than that of native vegetation. Saltcedar can contribute to increased vertical canopy density, creating volatile fuel ladders, thereby increasing the likelihood of negative impacts of wildfire. Saltcedar plants can have many stems and high rates of stem mortality, resulting in a dense accumulation of dead, dry branches vertically within the canopy as well as within the fuel bed. Large quantities of dead branches and leaf litter are caught in saltcedar branches above the ground surface, enhancing the crowns' flammability. In summary, the likelihood of fire in southwestern riparian ecosystems is greatest with the combination of flood suppression, water stress, and saltcedar presence. The presence of saltcedar in southwestern riparian ecosystems may favor its own propagation by further altering the natural disturbance regime, thereby further decreasing the already limited extent of native cottonwood and willow communities. Additionally, in the absence of flooding, regeneration of native trees is impeded, and organic matter accumulates, thus increasing chances for future fires that may further alter the species composition and structure of southwestern riparian systems and promote the spread of saltcedar and other fire tolerant species (<www.fs.fed.us/database/fesi/plants/tree/tamspp/fire_ecology>).

Once established in large stands saltcedar can rarely be controlled or eradicated with a single method, and many researchers and managers recommend combining physical, biological, chemical, and cultural control methods. Removing saltcedar must also be accompanied by an ecologically healthy plant community that is weed resistant and meets other land use objectives such as wildlife habitat or recreational use benefits. The best phenological stage to burn and reburn saltcedar to reduce density, canopy, and hazardous fuel loads is during the peak of summer, presumably due to ensuing water stress. Use of fire alone to control saltcedar, however, is generally ineffective, only killing above ground portions of the plant leaving the root crown intact and able to produce vigorous sprouts. Saltcedar stands can burn hot with erratic fire behavior with numerous firebrands transported downwind from the headfire. Prescribe fire set-up requires poorly receptive fuels downwind from the headfire. Saltcedar in dense stands that have not burned in 25–30 years exhibit extreme fire behavior and crowning due to closed canopy at any time of the year. They can have flame lengths exceeding 140 feet, resulting in near complete fuel consumption. Stands reburned after 5 to 6 years show vastly different fire behavior, carrying fire only if there is adequate fine fuel load and continuity. Due to the ability to transport fire brands at least 500 feet downwind, blacklines should be at least 700 feet wide, headfires installed with temperatures 65–95 degrees Fahrenheit, relative humidity of 25–40 percent, and wind speeds less than 15 miles per hour.

Managers must be prepared for extreme fire behavior in old decadent stands. Where high intensity fire is not preferred due to presence of less fire resistant vegetative species, fuel reductions through mechanical and chemical controls are recommended. Ignited prescribed fire can be used to thin dense saltcedar stands to follow-up applications of mechanical and chemical controls (www.fs.fed.us/database/feis/plants/tree/tamspp/fire_effects). Mechanical and chemical methods are commonly employed for saltcedar control (*Low-Impact, Selective Herbicide Application for Control of Exotic Trees: Saltcedar, Russian Olive and Siberian Elm A preliminary Field Guide by Doug Parker and Max Williamson*, USDA May 2003). November

through January is the most effective time to achieve first time kills of saltcedar by cutting below the root collar, probably because the plants are entering dormancy at that time and translocating resources into their roots. Whole tree extraction through use of equipment such as the patented Boss Tree Extractor (<www.bossreclamation.com>) has achieved 90 percent mortality subsequent to initial treatment. In areas where native riparian vegetation species or other habitat issues create a need for agile specific treatment designs, whole tree removal may be considered as the preferred treatment. Herbicide application is most effective when applied immediately after cutting. Full strength application of garlon® painted on cut stumps within 15 minutes of cutting or applied with a backpack sprayer using 20-30% mix of garlon® with Ag. Oil has been successful with the exception of spring months when sap is moving up from the root mass. (Doug Parker and Max Williamson, USDA, *Low-Impact, Selective Herbicide Application for Control of Exotic Trees: Saltcedar, Russian Olive and Siberian Elm A preliminary Field Guide*, May 2003). Extraction and mulching of saltcedar will require treatments of re-sprouts by mechanical or chemical control methods. Changes in nature of disturbance from fire (frequency, intensity, and severity) have been effected by both saltcedar invasion and by other changes in the invaded communities. Fire frequency and fire behavior in saltcedar invaded communities are thought to be different than in native plant communities. In the absence of flooding to remove debris, accumulation of woody material can increase to levels that may have a profound effect on the ecology of the system.

**Red Brome**

In general, red brome initiation and establishment is a direct response to fall rains. Initial growth is relatively slow, followed by a rapid increase in vegetative growth coinciding with warming spring temperatures. Flowering and fruiting generally occur in April and May. Seeds are disseminated in summer.

Red brome is commonly an early to mid-seral species in California chaparral. It is usually sparse in early succession chaparral systems of northern California but may increase rapidly in areas of low soil fertility and moisture. Peak population numbers require several years for seed dispersal into burns or buildup from on-site producers. Continued disturbance such as grazing and repeated low-severity fires favor red brome over native early-seral chaparral species.

Red brome generally shortens fire return intervals. The increased presence of red brome has promoted fires in areas where fire was previously infrequent due to insufficient fuels. Once established red brome may increase fire frequency by enhancing potential for start and spread. In general, red brome produces an abundant and continuous cover of persistent fine fuels, promoting fast, “hot” fires. Desert scrub-shrub and grasslands dominated by red brome are more susceptible to fire than areas dominated by native forbs. Dead red brome culms and blades are persistent (commonly 2 years); herbage of most desert annual species usually lasts 1 year or less. Red brome produces high amounts of persistent flammable fuels in perennial plant interspaces, promoting ignition and spread.

Heat generated by burning red brome is sufficient to ignite and consume dead stems of native desert forbs. Flames may also consume small shrubs such as white bursage (*Ambrosia dumosa*), winterfat (*Krascheninnikovia lanata*), white burrobush, and Anderson wolfberry (*Lycium andersonii*). However, flames fueled by red brome are generally insufficient to ignite large shrubs such as creosote bush.

Within the Sonoran Desert, dead and dry red brome is easily ignited, supporting fast-moving surface fires. Fire return intervals are also shortened, changing the vegetal composition through increase of non-native components and loss of native plant species. Arizona interior chaparral communities are composed of varying plant species compositions, enhanced by the predominate bi-modal rainfall patterns of Pinal County. Soils in this type are mostly shallow decomposed granite complexes that may hinder establishment of annual grasses. Red Brome can become a wildlife fire enhancing component in down slope desert scrub/shrub types in years of extraordinary rainfall.

**Cheatgrass**

Cheatgrass is most widespread in sagebrush steppe communities of the Intermountain West. Many of the ecosystems that cheatgrass has invaded are seriously altered, and no longer support the vegetation of the potential natural community. Cheatgrass can maintain dominance for many years on sites where native vegetation has been eliminated or severely reduced by grazing, cultivation, or fire. The concept of potential natural communities based only on native species is seriously challenged by cheatgrass. Where cheatgrass is highly adapted, it might have to be recognized as a component of the potential plant community. In these situations, cheatgrass may remain the de facto climax dominant, regardless of site potential. The following discussion focuses primarily on component species of potential natural communities that cheatgrass has invaded, from low-elevation salt-desert shrub communities in the southern Great Basin into higher-elevation juniper (*Juniperus* spp.), pinyon-juniper (*Pinus-Juniperus* spp.), pine woodlands, and the coniferous forest zone of the Rocky Mountains.

According to Stewart and Hull in 1949 and Beatley in 1966, only a few cheatgrass plants were found in black greasewood-shadscale (*Sarcobatus vermiculatus-Atriplex confertifolia*) and salt-desert shrub associations. Today, cheatgrass is common in these communities, especially in wet years. Associated species may include budsage (*Artemisia spinescens*), bottlebrush squirreltail (*Elymus elymoides*), Sandberg bluegrass (*Poa secunda*), and Indian ricegrass (*Achnatherum hymenoides*). Cheatgrass also occurs with blackbrush (*Coleogyne ramosissima*), galleta (*Pleuraphis jamesii*), and many other salt-desert species.

In the Intermountain West, and most specifically the sagebrush steppe and bunchgrass zones, cheatgrass occurs in and often dominates large acreages of rangeland where native dominants include big sagebrush (*Artemisia tridentata*), bluebunch wheatgrass (*Pseudoroegneria spicata*), Thurber needlegrass (*Achnatherum thurberianum*)], needle-and-thread grass (*Hesperostipa comata*), western wheatgrass (*Pascopyrum smithii*), basin wildrye (*Elymus cinereus*, Idaho fescue (*Festuca idahoensis*), rough fescue (*F. altaica*), bottlebrush squirreltail, low sagebrush (*Artemisia arbuscula*), spiny hopsage (*Grayia spinosa*), and rabbitbrush (*Chrysothamnus* spp.). Cheatgrass often co-occurs with Sandberg bluegrass and/or bottlebrush squirreltail, and on some Nevada sites has replaced Indian ricegrass or blue grama (*Bouteloua gracilis*). By 1932 cheatgrass had replaced big sagebrush on burned-over areas in the Great Salt Lake region of Utah, and occupied these sites in dense stands associated with cutleaf filaree (*Erodium cicutarium*), rabbitbrush, broom snakeweed (*Gutierrezia sarothrae*), and several other relatively unpalatable species and annual weeds. Cheatgrass invades sites dominated by silver sagebrush (*A. cana*) and blue grama in Wyoming.

In pinyon-juniper and mountain brush lands, cheatgrass can be found growing among Rocky Mountain juniper (*J. scopulorum*), western juniper (*J. occidentalis*), singleleaf pinyon (*Pinus monophylla*), Utah juniper (*J. osteosperma*), Colorado pinyon (*P. edulis*), Gambel oak (*Quercus gambelii*), Emory oak (*Q. emoryi*), antelope bitterbrush (*Purshia tridentata*), curlleaf mountain-mahogany (*Cercocarpus ledifolius*), skunkbush sumac (*Rhus trilobata*), snowberry (*Symphoricarpos* spp.), serviceberry (*Amelanchier pallida*), and mountain big sagebrush.

Disturbance: Often the critical factor opening niches for cheatgrass invasion is a heightened disturbance regime. Cultivation and subsequent land abandonment, excessive livestock grazing, overstory removal, and repeated fires can interact, or act singly, to proliferate cheatgrass. Excessive grazing and frequent fires can damage biological soil crusts and many perennial plants, thus encouraging cheatgrass establishment, survival, persistence, and dominance. Where fires have occurred at higher elevations, bunchgrasses have recovered vigorously with little cheatgrass invasion. Cheatgrass is less invasive in mesic environments, where it does not compete as effectively with established perennial grasses.

Fire adaptations: Cheatgrass establishes from soil-stored and transported seed after fire. It has long been known that cheatgrass is highly adapted to a regime of frequent fires. Cheatgrass has a very fine structure, tends to accumulate litter, and dries completely in early summer, thus becoming a highly flammable, often continuous fuel. By the time of burning most cheatgrass seeds are already on the ground, and those not near the heat of burning shrubs can survive and allow cheatgrass to pioneer in the newly burned area. Even if fire comes when cheatgrass plants are still green and kills them before they can set seed, there may be enough viable cheatgrass seed in litter and upper layers of soil for plants to reestablish.

Cheatgrass is a strong competitor in the postfire environment, where it takes advantage of increased resource availability and produces an abundant seed crop. A cheatgrass population may average around 1,000 plants per square foot (10,750 per $m^2$) prior to burning. During a wildfire, most of the cheatgrass seeds beneath a shrub canopy may be killed by the heat associated with the burning of the shrub. Some cheatgrass seeds located in the interspaces among shrubs are also consumed, while those that are buried or lying in cracks in the soil will likely survive. The next season, surviving seeds germinate and establish at a density of about 1 plant per square foot ($11/m^2$). These plants are released from competition, and have more water and nutrients available to them. The cheatgrass plants in this sparse population can produce abundant tillers, each supporting many flowers, thus producing a large seed crop.

Fire facilitates cheatgrass dominance on some sites by interrupting successional trajectories of postfire plant communities, and cheatgrass facilitates fire and can thus shorten the interval between fires. This grass/fire cycle is a serious ecological threat on sites where most native plant species are poorly adapted to fire and is recognized in many ecosystems worldwide. This cycle has been documented in the Great Basin since the 1930s, and has been reported in the Mojave and Sonoran deserts beginning in the early 1980s. The result is a type conversion from native shrub and perennial grasslands to annual grasslands adapted to frequent fires.

Fire regimes: Cheatgrass expansion has dramatically changed fire regimes and plant communities over vast areas of western rangelands by creating an environment where fires are easily ignited, spread rapidly, cover large areas, and occur frequently. Cheatgrass promotes more frequent fires by increasing the

biomass and horizontal continuity of fine fuels that persist during the summer lightning season and by allowing fire to spread across landscapes where fire was previously restricted to isolated patches. Fire in these habitats can have severe effects on native species of plants and animals, although the impact of fire regime changes may differ by region and ecosystem type due to differences in the composition and structure of the invaded plant communities and to climatic differences such as occurrence of summer thunderstorms.

Postfire desert scrub-shrub plant communities are typically dominated by nonnative annual grasses, so burned areas are likely to be more susceptible to fire than unburned areas. Repeated fires stress and kill native perennials. Eventually wind and water erosion may occur, removing and diluting soil organic matter and attendant nutrient concentrations and safe sites around shrubs. After fire has eliminated native perennials, essential mycorrhizae may also be eliminated. Biological soil crusts are also killed by severe fire, and the unusually large, frequent fires associated with cheatgrass dominance can preclude crust species recolonization and succession.

Cheatgrass fire regime: Cheatgrass often dominates postfire plant communities, and once established, cheatgrass-dominated grasslands greatly increase the potential and recurrence of wildfires. Cheatgrass fires tend to burn fast and cover large areas, with a fire season from 1 to 3 months longer than that of native rangeland. The average fire-return interval for cheatgrass-dominated stands is less than 10 years. This adaptation to and promotion of frequent fires is what gives cheatgrass its greatest competitive advantage in ecosystems that evolved with less frequent fires. The cheatgrass-fire cycle is self-promoting, as it reduces the ability of many perennial grasses and shrubs to re-establish and furthers the dominance of cheatgrass. Moisture availability can affect cheatgrass productivity and thus affect fuel loads on a site. Drought years may reduce the dominance of cheatgrass in both recently burned and unburned areas, thus decreasing fuel loads and the chance of fire.

Immediate fire effect on cheatgrass: Live cheatgrass plants are susceptible to heat kill, as with a flame thrower or handled propane torch, though they are difficult to burn when green. When cheatgrass plants are dry enough to burn, they are already dead, and have already set seed. Fire will then reduce cheatgrass plants to ash.

Cheatgrass seeds are also susceptible to heat kill, but can survive fires of low-severity if the entire litter layer is not consumed or if seeds are buried deeply enough to be insulated from the heat. The amount of litter or ash left on a site is a good indicator of the amount of cheatgrass seed surviving on that site. Low density of cheatgrass immediately following fire indicates either low numbers of cheatgrass seed in the seed bank, or poor survival of seeds during fire.

Discussion and qualification of fire effect: The effects of fire on cheatgrass plants and seeds vary with timing and severity of fire and the composition and density of the prefire plant community. If fire occurs when seed remains in panicles above ground, most seeds will be killed and cheatgrass density will decline immediately following fire. The chances of seed surviving fire are enhanced once they have dispersed onto or beneath the soil surface. The woody biomass of some desert shrub, plus litter accumulations, provide sufficient fuel to elevate temperatures high enough for a long enough period to consume cheatgrass seeds on these microsites. Some cheatgrass seeds in the interspace zones are also consumed by fire, but many

survive even though the cheatgrass herbage is completely consumed. Fire from herbaceous fuel alone is not usually hot enough to consume cheatgrass seeds. Although fires in pure cheatgrass stands, without woody fuel, are less severe, cheatgrass seed banks can be substantially reduced after fire.

Discussion and qualification of plant response: Cheatgrass response to fire depends on plant community and seed bank composition, density, and spatial distribution; season of burning; fire severity, frequency and patchiness; scale of consideration; postfire management; and climatic conditions. Generalizations are difficult because each combination of climate, vegetation, and soil must be considered separately, as well as considerations of environmental differences both at the time of burning and during subsequent plant reestablishment.

Timing of fire: If burned during a crucial time during seed ripening, fire can greatly reduce the density of the succeeding cheatgrass stand; however, postfire seed production may equal or exceed that of the prefire population, resulting in increased density the following year. Timing of fire is important also because of variable damage to potential competitors in the native community. For example, cool-season perennial grasses such as bluebunch wheatgrass and western wheatgrass may be less damaged by late-summer wildfires than by fires earlier in the growing season.

Fire size and frequency: Nonnative, invasive grasses generally benefit from fire and promote recurrent fire. Fire kills biologic soil crusts, thereby allowing more germination sites for cheatgrass for several years or even decades, as crusts are slow to recover. Recurrent fires also tend to enhance cheatgrass dominance because native species cannot usually persist under a regime of frequent fires. Native plant assemblages are thus converted to nonnative annual grasslands. Frequency and size of fires is then further increased.

Fire management considerations: As a management tool, fire can be used to either kill unwanted species or to simulate historic fire regimes and promote desired species. Historic fire regimes did not occur in the presence of many invasive plants that are currently widespread, and the use of fire may not be a feasible or appropriate management action if fire-tolerant invasive plants are present. For example, while fire may be an important natural component of the Great Basin ecosystem, its reintroduction by land mangers is complicated by the presence of invasive plants such as cheatgrass. Fire management should be conducted in ways that prevent establishment of invasive species, and the management of fire and invasive plants must be closely integrated for each to be managed effectively.

Rasmussen presents considerations (e.g. species composition, fuel load, fuel continuity, and weather) to be addressed when using prescribed fire in sagebrush steppes, and general prescriptions that could be used. When precipitation is below 12 inches (300 mm), caution should be used to ensure desired plant response. If the objective is to maintain the perennial herbaceous vegetation, prescribed burning is most effective when used before sagebrush dominates the site and effectively excludes perennial herbaceous plants. Such timing reduces the need for seeding following a burn. If the objective is to maintain the sagebrush, prescribed burning has very limited applicability.

Cheatgrass fuels: In the absence of grazing, grass biomass during the fire season may represent 2 years of fuel accumulation, which appears to be optimal for grassland fires. Abundant, continuous cover of cheatgrass can lead to rapid spread of wildfires so that under conditions of high temperatures, low humidity, and wind, the fires are very difficult to suppress.

Brooks compared the roles of nonnative annual grasses and other annual plants in facilitating the spread of fires in the Mojave Desert. Landscapes dominated by nonnative annual grasses, especially annual bromes (*Bromus* spp.), are more flammable than those dominated by native forbs. Possible explanations for this include higher surface-to-volume ratio of grasses compared to forbs; more continuous vegetative cover; and the ability of alien annual grasses to remain rooted and upright longer than native forbs, allowing them to persist as flammable fuels into the summer when the threat of fire is highest. Thick layers of annual plant litter accumulate, and litter decomposes especially slowly in desert regions. Accumulations of litter led to particularly hot temperatures, long flame residence times, and continuous burn patterns in experimental fires in the Mojave Desert.

Cheatgrass provides a flammable link between open grasslands and forests. It cures early in the fire season and ignites readily during dry periods because of its finely divided stems and pedicels, and it responds readily to changes in atmospheric moisture because of its fine structure. Moisture content is the single most important factor influencing cheatgrass flammability, and varies with plant phenology and color change as follows:

| Plant color | Moisture content (%) |
|---|---|
| Green | >100 |
| Purple | 30–100 |
| Straw | <30 |

Since there is considerable variation in plant coloration in a stand, close inspection is necessary to determine the predominant coloration. Cheatgrass is not readily ignitable until it reaches the straw-colored stage. The time required for the moisture content to drop from 100% to 30% ranged from 8 days on a northern exposure in western Montana, to 23 days on a southern exposure in different years, with an average of 14 days. The onset of purple coloring forewarns of hazardous fire conditions within about 2 weeks.

Cheatgrass ignites and burns easily when dry, regardless of quantity, and can support rapid rate of fire spread. Flammability of cheatgrass fuels depends primarily on moisture content, weight, and porosity.

Fuel management/fire prevention: On areas where cheatgrass is abundant, special measures may be necessary to prevent recurrent fires, and thus prevent the elimination of fire-sensitive perennial grasses and forbs and other potential adverse impacts. Fire suppression can discourage invasion and spread of cheatgrass. Grazing management to reduce fuel loads and greenstripping are 2 methods employed to prevent large recurrent fires in areas dominated by cheatgrass. Additionally, herbicides are being tested for effectiveness in creating fuelbreaks in cheatgrass-dominated range.

Cattle grazing can reduce the accumulation of cheatgrass litter and thus lessen the fire hazard on a site. Grazing cheatgrass in winter can reduce cheatgrass herbage and seeds while protecting the dormant perennial grasses. Davison provides more detailed information on using livestock grazing to reduce fuel loads and subsequent fire occurrence and severity in cheatgrass-dominated rangelands.

Greenstripping is a method of establishing fuel breaks to impede the flow of wildfires and thereby increase the fire-free interval on a site dominated by cheatgrass. These fuel breaks are 30 to 400 feet (10-120 m) wide, and are seeded with fire-resistant vegetation. As of 1994, 451 miles (16,280 acres) of experimental and operational greenstrips had been established in Idaho. The effectiveness of greenstrips, or any fuels modification project, in reducing wildfire spread is enhanced by 3 factors: 1) disrupting fuel continuity (e.g. by replacing cheatgrass with caespitose grasses such as crested wheatgrass, which have large spaces between individual shrubs); 2) reducing fuel accumulations and volatility (e.g. shrub stands are thinned to maintain a minimum distance of 10 feet (3 m) between plants); and 3) increasing the density of plants with high moisture and low volatile oil content, thus reducing both the potential for ignition and rate of fire spread. Plants used in greenstrips remain green and moist into late summer, making the greenstrip area less flammable for a longer time. Wildfire speed may slow when entering a greenstrip, thus allowing fire suppression crews to extinguish the fire. Some wildfires burn into greenstrips and extinguish. Native plants in the Great Basin generally do not meet firebreak criteria. Crested wheatgrass and forage kochia are effective in retarding wildfire spread, compete well in a weedy environment, and have been the most successful species in greenstrips. Both plants can, however, be invasive and spread into areas where cheatgrass is being managed with prescribed fire.

Revegetation after cheatgrass fires: After wildfires or when planning prescribed burning in areas where cheatgrass is present, managers must decide whether the burned area should be seeded or whether sufficient perennial grasses are present to revegetate a site and successfully compete with cheatgrass. Seeding may not be necessary or desirable if native plant species are able to recover after fire. Cheatgrass-dominated communities tend to have extremely sparse perennial seed banks, however, and the cheatgrass seed bank generally recovers by the 2nd postfire year. In Utah, natural revegetation (no seeding) is most effective at higher elevations where sufficient moisture and a diverse population of perennial vegetation exist, especially on north- and east-facing slopes. Below 6,000 feet (1,820 m) and in much of Utah's arid environment, cheatgrass and other weedy species readily invade and dominate burned areas. Seeding following fire may be needed to prevent cheatgrass dominance in Wyoming big sagebrush and pinyon-juniper communities, but not in mountain big sagebrush communities.

Revegetation of burned areas is desirable to assure forage for livestock and wildlife, and to minimize the potential for erosion and/or invasion by nonnative species. Ideally, wildfire rehabilitation should enhance the recovery of native vegetation through the seeding of native plants adapted to local environmental conditions. Early seral species may provide managers with native plant materials that can successfully germinate and establish in the presence of invasive annuals and do well after subsequent fire. Bottlebrush squirreltail deserves consideration as a post-wildfire revegetation species because in greenhouse experiments, it has substantially greater growth in post-wildfire soil compared with unburned soil, and exhibits relatively higher growth rates in post-wildfire soil compared to cheatgrass. Restoration projects using native species mixes to provide a variety of above- and belowground growth forms, and sowing at high densities, may increase establishment of desirable plants while providing adequate competition against invasive plants. Federal policy currently encourages the use of native plant materials on public lands; but because the primary objective of wildfire rehabilitation on public lands is not ecological restoration but rather prevention of erosion and invasion by undesirable nonnative species, and because of

the limited availability of native seeds, the use of native species is not mandatory for revegetation. Because of difficulties related to cost, handling, and reliability of native seed supplies in wildfire rehabilitation situations, many managers prefer nonnative plant materials and traditional seeding methods.

Many large areas have been seeded with nonnative, herbaceous forage species including crested wheatgrass, intermediate wheatgrass, tall wheatgrass (*Thinopyrum ponticum*), Russian wildrye (*Psathyrostachys juncea*), smooth brome, alfalfa, and yellow sweetclover (*Melilotus officinalis*). Seeds for these species are readily available and responsive to standard seeding methods; plants establish and grow rapidly, and have wide environmental tolerances. Many cultivars are also drought tolerant, grazing tolerant, and competitive against other, less desirable nonnative species. The most reliable and persistent grass for low-elevation, drought-prone areas of the Intermountain West is crested wheatgrass. It establishes rapidly even under relatively dry conditions and tends to persist for many years, although some sites seeded to crested wheatgrass return to cheatgrass dominance over time. Grasses that are most competitive against cheatgrass include 'Hycrest' crested wheatgrass, 'Luna' intermediate wheatgrass, 'Bozoisky' Russian wildrye, and smooth brome. The competitive advantage for establishment of crested wheatgrass seedlings is lost if burned areas are not seeded the year of the fire. Forbs such as alfalfa tend to have low persistence in rehabilitation seedings. Current goals of making wildfire rehabilitation objectives compatible with other management objectives on public lands may require careful planning of treatments and some modifications of standard practices, such as greater use of native plants. The identification and use of competitive native perennial plants for arid-land rehabilitation has become a priority for managers and researchers. In big fire years - such as 1996, when millions of acres burned - the scale of the demand for seed greatly exceeds the supply of native plant seed, especially of local genotypes. The competitive ability of nonnative species and the relatively low cost and high availability of their seed will continue to appeal to those faced with of large-scale burns in cheatgrass-prone areas. If managers are able to predict large fires in advance, perhaps more efforts could be made to have more native seed available for specific sites.

**Buffelgrass**

Buffelgrass is native to Africa, India, and western Asia. It was introduced into Texas in the 1940s to stabilize overgrazed rangelands and provide livestock forage. It was introduced into Arizona in the 1930s and 1940s to control erosion. Buffelgrass also established in Arizona from seed dispersed from Sonora, Mexico, where over 1,000,000 acres (400,000 ha) of native desert and thornscrub vegetation was converted to buffelgrass pasture. Buffelgrass was first collected on the island of Hawaii in 1932. It was intentionally planted on Kaho'olawe Island, Hawaii in 1988 and 1990. The literature does not describe how buffelgrass arrived in other areas of the United States. Buffelgrass has also been introduced into Australia, where it is considered highly invasive.

Buffelgrass occurs in the southern United States from California to Florida (with the exception of Alabama, Georgia, and the panhandle of Florida), with outlying populations in Oklahoma, Missouri, and New York. It also occurs in Puerto Rico and Hawaii. In North America, buffelgrass is most prominent in the Sonoran Desert of southern Arizona and northern Mexico, and the Chihuahuan Desert of southwestern Texas. Buffelgrass occurs in desert and thornscrub communities in southern Arizona and northern Mexico. It occurs in communities dominated by brittle bush (*Encelia farinosa*), acacia (*Acacia* spp.), Arizona mimosa

(*Mimosa distachya* var. *laxiflora*), honey mesquite (*Prosopis glandulosa* var. *glandulosa*) creosotebush (*Larrea tridentata*), saltbush (*Atriplex* spp.), bursage (*Ambrosia* spp.), desert ironwood (*Olneya tesota*), yellow paloverde (*Parkinsonia microphylla*), and/or saguaro (*Carnegiea gigantea*).

The two greatest impacts of buffelgrass in the United States are the alteration of plant communities and fire regimes in the Sonoran Desert. In a news article, United States Geological Survey researcher Julio Betancourt describes the establishment and spread of buffelgrass in the Sonoran Desert of Arizona as "one of the most impressive ecosystem conversions happening in North America." Williams and Baruch describe buffelgrass as "one of the world's most notorious invaders." Buffelgrass was introduced into Arizona by the Natural Resources Conservation Service in the late 1930s and early 1940s. The spread of buffelgrass in the Sonoran Desert of Arizona now is largely from seed from Mexico. On the plains of Sonora, buffelgrass distribution has expanded from 19,000 acres (7,700 ha) in 1973 to over 350,000 acres (140,000 ha) in 2000. As of 2006, as much as 4 million acres (1.6 million ha) has been seeded to buffelgrass in Sonora. Between 1990 and 1998, the Mexican government subsidized cattle ranchers to convert native desert and thornscrub to buffelgrass pastures. The vast conversion of native communities to buffelgrass pasture may facilitate the spread of buffelgrass not just into native communities in the Sonoran Desert of Mexico and Arizona, but also into the Mojave and Sonoran Desert of California and Baja California. Buffelgrass persistence and spread can lead to reduced richness and diversity in invaded communities in the Sonoran Desert. When native trees are replaced by buffelgrass, a large guild of associated plants and animals also disappears from the area. Unpublished data cited by Burquez and others indicate severe reductions of native plant richness and diversity and less vertical complexity in buffelgrass grasslands compared to native desert scrub. Large reductions in standing crop biomass were also calculated: from 5 to 20 Mg/ha in native vegetation, to 1 to 4 Mg/ha in buffelgrass. Most native vegetation that is removed for the establishment of buffelgrass pastures is burned, resulting in substantial losses of carbon from these ecosystems as $CO^2$. Thus the widespread conversion (both active and passive) of native desert scrub to buffelgrass grasslands may have implications for climate change.

Buffelgrass establishment and spread are associated with a reduction or loss of native plant species in the Sonoran Desert, the Lower Rio Grande Valley, Hawaii, and Australia. In areas where buffelgrass occurs, it often "outcompetes" native species for limited water and nutrient resources by germinating earlier, growing faster, and creating denser stands than native plants. Buffelgrass can negatively affect native plant species richness in areas where it is dominant.

At the time of this writing (2008), buffelgrass impacts on native plant communities are greatest in the Sonoran Desert. In the Sonoran Desert of northwest Mexico, buffelgrass invasions in columnar cactus (*Pachycereus pecten- aboriginum*) stands severely affect cactus reproduction. While buffelgrass does not affect cactus seed production, seedlings fail to establish in buffelgrass stands. Buffelgrass established in the Organ Pipe Cactus National Monument, Arizona, during the 1970s and 1980s. By 1994, it occupied 20 to 25 square miles (50-65 $km^2$) of the monument and was spreading rapidly. At Organ Pipe Cactus National Monument, buffelgrass reduces abundance of native shrubs such as creosotebush, saltbush, and bursage, as well as abundance of associated native grasses and forbs.

Buffelgrass is described as a fire-adapted species. Fire adaptations vary with reproductive morphology, which varies among forms. Buffelgrass may establish, persist, and spread following fire. Buffelgrass may

establish from on-site seed sources after fire. However, in Botswana, no buffelgrass seeds survived prescribed burning when harvested from a savanna and sown on the soil surface in a curlyleaf (*Eragrostis rigidior*) plant community before burning. It is possible that buried or protected buffelgrass seed may survive and germinate following fire. Buffelgrass seed is dispersed by multiple sources, so it may establish on burned sites via offsite seed sources. More information is needed on seed banking and heat tolerance of buffelgrass seeds.

Buffelgrass can persist after fire by sprouting from rhizomes, tillers, or buds that survive fire. Sources describe buffelgrass as simply “sprouting” or “rapidly resprouting” after fire, without indicating the source of sprouts. Esque and others state that buffelgrass resprouts rapidly from the root crown after fire. New buffelgrass growth can appear as soon as 5 to 10 days following complete top-kill by summer fires; however, postfire response of buffelgrass may depend on season of burning and postfire weather conditions. Buffelgrass fine fuel loads are generally much higher than fine fuel loads from native plants in desert environments. Thus, fires in buffelgrass stands may have longer flame lengths, greater rates of spread, and higher temperatures than fires in native desert vegetation, and cause high mortality in native flora and fauna. Buffelgrass stands burn “very hot” and can burn when green. In the Sonoran Desert, buffelgrass-fueled fires can reach temperatures so hot that the soil is scorched and the bedrock cracked. Headfires in buffelgrass stands can reach temperatures of 1,090 to 1,300 °F (585-700 °C). Esque and others state that buffelgrass grows into an “almost-woody subshrub”, accumulating flammable material overseveral years, “in effect unlinking fire frequency from annual climatic variability and increasing the fire intensity.”

Buffelgrass fuel loads in Saguaro National Park are large enough to carry fire and were found to be high in comparison to fine fuels from annuals in warm desert biomes of North America. Fine fuels from annuals (natives and nonnatives combined) typically range from 0 to greater than 625 lb/acre in warm deserts. In June 2003, buffelgrass fuel loads on 14 plots in 2 areas of Saguaro National Park (4 at Javelina Picnic Area and 10 at Panther Peak) were measured. During the year of the study, sites received less than 10.5 inches (267 mm) of rain and buffelgrass moisture content was very low (3.6%). Nevertheless, buffelgrass dry, aboveground biomass averaged 2,523 lb/acre and 2,213 lb/acre on the 2 sites.

Buffelgrass growth and spread are greatest in wet years. In northwestern Sonora, Mexico, buffelgrass production was measured in summers of below- and above-average precipitation. On northwestern Mexican rangelands, peak growth is in August. Production ranges from 1,000 lbs/acre in dry years to 6,000 lbs/acre in wet years. Average summer (July-September) precipitation in Sonora is 7.56 inches (192 mm). During the summer of 1987, precipitation was 5.75 inches (146 mm) below average and buffelgrass biomass production was 465 kg/ha. During the summer of 1986, precipitation was above average by 14.1 inches (358 mm), and buffelgrass biomass production was 3,025 kg/ha. On the Desert Laboratory grounds of Tucson, Arizona, buffelgrass “greatly” expanded its range following 2 unusually wet summers. Buffelgrass had been on the site since 1968.

Although buffelgrass has been in North America for many decades, in the last couple of decades it has spread to the point of altering fuel characteristics and impacting fire regimes of native desert communities. Research regarding its impacts on native fire regimes is limited at the time of this writing (2008), although abundant anecdotal evidence is available. A 2001 review article by Brooks and Pyke describes how

buffelgrass and other nonnative plants are beginning to alter fire regimes in the Sonoran Desert. Brooks and Esque warn that shortened fire-return intervals caused by invasive grasses, including buffelgrass, pose a serious threat to plants and animals in the Sonoran Desert.

While buffelgrass occurs in many of the southern States, the majority of buffelgrass fire ecology information comes from areas in the Sonoran Desert, including central and northern Sonora, Mexico, and southern Arizona. In these areas, buffelgrass invasion can increase the biomass and continuity of fine fuels, resulting in large and frequent fires. Buffelgrass also fuels frequent fires in Hawaii and Australia. In central Australia, buffelgrass produces 2 to 3 times as much flammable material as native grasses on some sites. Historically, watercourses were natural firebreaks, but the expansion of buffelgrass in watercourses from water-dispersed seed have turned these areas into “wicks” for fire.

Historically, fires were rare in the Sonoran Desert because fine fuels were sparse and discontinuous and rarely carried fire. The primary carriers of contemporary fires in the Sonoran Desert are introduced perennial plants. In contrast to native species, buffelgrass produces a large amount of continuous, fine fuel, thereby increasing the potential for frequent, intense, and large fires. The buffelgrass fire season in the Sonoran Desert begins at the end of the summer rainy season in late September and continues until the following July when the summer rains return. During winter rains and the cool-season growth period, however, buffelgrass-fueled fires are fewer than in the warm, dry months.

The fire hazard caused by buffelgrass in the Sonoran Desert of Arizona and northern Mexico is increasing. In a news article, a fire inspector in Tucson, Arizona, said, “buffelgrass is like taking a kiddie pool, filling it with gas, and putting it in your front yard.” He claimed that buffelgrass fires can go from 4-foot (1 m) flames to 30-foot (10 m) flames in 20 seconds. He described the desert surrounding Tucson as formerly “fire resistant”, but 15 to 20 buffelgrass-fueled fires occurred within a 6-week period during the summer of 2007. Similarly, in Hermosillo, Sonora, Mexico, fires were virtually unknown prior to the establishment of buffelgrass in the 1940s. By the 1960s, sporadic buffelgrass-fueled fires were reported. By the late 1990s, buffelgrass-fueled fires had increased to 1 fire every 2 days during the dry summer months.

If buffelgrass continues to spread in the Sonoran Desert, it is likely to lead to a grass/fire cycle, negatively impacting the persistence of native vegetation. While some Sonoran Desert plants can establish or sprout following fire, many cannot. Native plant establishment via seed may take 20 or more years after fire to return to prefire vegetative cover. Buffelgrass can sprout quickly after fire and “outcompete” or even replace native plants. Cacti in the Sonoran Desert may be able to survive a single fire; however, a second fire within 10 years may be “catastrophic” to cacti. Buffelgrass-fueled fires may lead to decline of saguaro, yellow paloverde, and other native Sonoran Desert plants. In a review, West and Nabhan reported that buffelgrass burns so hot in the Sonoran Desert Biological Reserve that desert ironwood (*Olneya tesota)* trees are completely consumed, and the native desert vegetation is replaced by a dry grassland with no recruitment of native perennials. Esque and others also describe buffelgrass-fueled fires near El Batamote, Mexico completely incinerating desert ironwood and fragrant bursera (*Bursera fagaroides*) trees.

Fire in the Sonoran Desert negatively affects bird habitat quality. Buffelgrass fuels frequent and intense fires that remove native vegetation crucial for some bird species. Buffelgrass fires in national parks and national wildlife refuges in Texas and Arizona threaten desert tortoises, jaguarondis, and ocelots, and other

animals that depend upon woody plants or dense litter. Clearing native vegetation and replacing it with buffelgrass in southern Sonora, Mexico, has caused a decline in the Tarahumara frog. The conversion of desert scrub and foothill thornscrub to buffelgrass pastures in the Sonoran Desert is "devastating" to the Sonoran Desert tortoise. Fires that generally follow the transformation of native vegetation to buffelgrass are converting vast areas of tortoise habitat into tracts of nonnative grasslands. In Australia, the expansion of buffelgrass is associated with a decrease in vertebrate and invertebrate diversity.

Control: Given that buffelgrass has only become a problematic species in the United States within the last 10 to 20 years, research on its control is limited. At the time of this writing (2008), physical removal of buffelgrass seems to be the best control method available. Some research suggests that buffelgrass can be controlled by herbicide applications. Physical removal may be the best method of controlling buffelgrass. Based on research by Ward and others, manual removal of buffelgrass should take place at least 4 days after periods of precipitation that exceed roughly 0.67 inch (17 mm).

Physical removal of buffelgrass can be successful if sites are treated for at least 2 years. In year 2, seedlings need to be removed prior to maturity. In 1994, physical removal (hand pulling and digging with a shovel) of buffelgrass at Organ Pipe Cactus National Monument was initiated in a test plot. The following winter, many buffelgrass seedlings were removed from the site. By 1996, seedlings were not found at the site. At west Quitobaquito Springs, physical removal of buffelgrass resulted in almost no reestablishment. Large-scale physical removal of buffelgrass in the monument has proven successful. Sites where buffelgrass is most likely to reestablish following physical removal include burned sites, buffelgrass stands at least several years old, areas near a seed source, areas where vehicles or humans move through a site, areas with white-throated woodrat middens, or areas with topsoil loss due to erosion or bulldozing.

There is very little information on the prevention of buffelgrass establishment and spread. Further information on this topic is needed. On Tumamoc Hill, Arizona, a group known as the "Weedwackers" has initiated a program of revegetating disturbed areas with native species to prevent buffelgrass establishment. The program has been successful at eliminating buffelgrass stands in washes; leading to the reestablishment of native vegetation.

An integrated management program at 2 sites on the island of Hawaii successfully removed buffelgrass, allowing the establishment of native pili grass. Burns were conducted in February 1998, then reburned once or twice in the next 4 years. On some plots, burning was combined with hand pulling or glyphosate treatment. All sites were seeded with pili grass 3 weeks after the first burn, and watered to counteract effects of drought. In 2002, 4 years after the initial treatments, pili grass cover was less than 10% on unburned and burn-only plots, but was approximately 34% on plots from which buffelgrass had been removed.

Beginning around 2000, the group "Weedwackers" physically removed 4,600 tons (4,200 t) of buffelgrass and other exotic species from roadsides, vehicle pullouts, and washes in Tucson Mountain Park, Arizona. Using National Park Service funding, volunteers removed over 40 tons (40 t) of buffelgrass from Organ Pipe Cactus National Monument between 1994 and 2004.

### Mediterranean Grass

Two similar species are known as Mediterranean grass, *Schismus barbatus* and *Schismus arabicus*. Mediterranean grass is a low growing tufted grass (under 20 cm tall) that is abundant in many areas of the desert southwest. According to *Invasive Non-Native Plants that Threaten Wildlands in Arizona* (Arizona Wildlands Invasive Plant Working Group 2005) both species of *Schismus* are ranked a Medium threat level for Arizona's wildlands. A medium ranking means that these species have a substantial impact to Arizona's ecosystems; have invasive attributes that are conducive to moderate to high rates of dispersal, often enhanced by ground disturbance; and are found with a diversity of ecosystems and the distribution with those ecosystem can range from limited to widespread.

# APPENDIX F. NATIONAL FIRE AND AVIATION EXECUTIVE BOARD APPROPRIATE MANAGEMENT RESPONSE

# National Fire and Aviation Executive Board

Memorandum

To: Fire Management

**From: National Fire and Aviation Executive Board**

**Date: June 20, 2007**

**Subject: Clarification of Appropriate Management Response**

The National Fire and Aviation Executive Board (NFAEB) provides the following clarification for implementing the Appropriate Management Response (AMR) under current Federal Wildland Fire Management Policy and agency directives. The intent is to clarify Federal Wildland Fire Management Policy, to enable agency administrators to take full advantage of the flexibility afforded by existing policy.

**Key Points to Clarify Policy**:

The Interagency Strategy for the Implementation of Federal Wildland Fire Management Policy (2003) is the primary wildland fire policy reference source. Agencies have incorporated policy intent and direction from that source in respective directives, manuals, handbooks, and interagency operations guides.

The Federal Fire Policy requires all wildland fires from unplanned ignitions to be managed for either protection objectives (wildfire) or resource benefit objectives (wildland fire use). Under current policy, a single fire cannot be managed for both objectives concurrently.

Appropriate Management Response (AMR) encompasses all of the response actions necessary to manage a wildfire or wildland fire use event for the duration of the event. In implementing the AMR, the full spectrum of tactical options, from monitoring a fire at a distance to intensive suppression actions are available to the fire manager. Beginning with the initial response to any wildland fire, decisions will reflect the goal of using available firefighting resources to manage the fire for the most effective, most efficient and safest means available.

The AMR strategies and tactics used to manage a wildland fire will be based on objectives identified in the Land/Resource Management Plan and/or Fire Management Plan.

The AMR strategies and tactics will consider firefighter and public health and safety, fire cause, current and predicted weather, current and potential fire behavior and fire effects, values to be protected from fire, management priorities, resource availability, cumulative effects of the fire, and cost effectiveness. Direct assessment of resource benefits from fire is currently allowed only where wildland fire use has been identified in the Land/Resource Management Plan and/or Fire Management Plan as an acceptable strategy.

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