Maricopa County
Community Wildfire Protection Plan

APRIL 2010

Arizona State Forestry Division
Maricopa County Department of Emergency Management
US Department of the Interior Bureau of Land Management
Tonto National Forest
Fort McDowell Indian Community
Gila River Indian Community
Tohono O'odham Indian Nation San Lucy District
Salt River Pima-Maricopa Indian Community

Aguila
Apache Junction
Avondale
Buckeye
Buckeye Valley
Cave Creek
Circle City/Morristown
Carefree
Chandler
El Mirage
Fountain Hills
Gila Bend
Glendale
Gilbert
Guadalupe
Goodyear
Harquahala
Litchfield Park
Mesa
New River
Peoria
Phoenix
Paradise Valley
Queen Creek
Rio Verde
Scottsdale
Sun City
Sun City West
Sunflower
Sun Lakes
Surprise
Tempe
Tolleson
Tonopah
Wickenburg
Wittmann
Youngtown

Maricopa County
Community Wildfire Protection Plan

April 2010

Prepared by:
Logan Simpson Design Inc.
33 North Stone Avenue
Suite 1460
Tucson, AZ 85701

(520) 884-5500
www.logansimpsondesign.com

LOGAN SIMPSON
DESIGN INC.

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ACRONYMS AND ABBREVIATIONS

AMR	Appropriate Management Response
APS	Arizona Public Service
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
CWPP	community wildfire protection plan
dbh	diameter at breast height
drc	diameter at root collar
FMU	Fire Management Unit
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
MCDEM	Maricopa County Department of Emergency Management
MJPT	Multi-Jurisdictional Planning Team
MLRA	Major Land Resource Area
PNVG	potential natural vegetation group
PPE	Personal protection equipment
R_x	prescribed fire
SR	state route
SRP	Salt River Project
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: MARICOPA COUNTY COMMUNITY WILDFIRE PROTECTION PLAN

The Maricopa 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 Maricopa County, Arizona, located in and around public lands administered by the US Department of the Interior Bureau of Land Management (USDI BLM) Phoenix District Office and the Tonto National Forest (TNF). 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. Maricopa 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 Maricopa 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 Maricopa County located east of Interstate 17 (I-17) and east of Interstate 10 (I-10), and the Western Core Team includes all identified at-risk communities west of I-17 and I-10. The Core Teams agreed to and established an efficient process to be followed throughout the Maricopa County CWPP development. The Core Teams identified 44 communities and analyzed 3,103,370 acres for potential risk from catastrophic wildland fire within Maricopa County.

Section I. Introduction

A primary objective of a CWPP is to help local governments, fire departments and district, 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. Maricopa 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 Maricopa 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 Maricopa County CWPP. This section establishes all necessary planning components and clearly articulates the intent of the Maricopa County CWPP, discloses the communities identified for analysis, and ensures that the Maricopa 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. The Maricopa County CWPP describes the commitment to hazard mitigation by Maricopa County and local jurisdictions by preparing the first Maricopa County Multi-Jurisdictional Hazard Mitigation Plan (2004 Plan). This section ties the multi-jurisdictional planning team (MJPT) collaborative effort to review, evaluate, and update the 2004 Plan into a single, consolidated Maricopa County Multi-Jurisdictional Hazard Mitigation Plan (Plan). The Plan also contains a Tribal Annex for each of the two participating Indian Tribes that address Tribal specific planning elements (MCDEM 2009).

The Maricopa County CWPP was developed to be complimentary to the Plan by developing a quantitative analysis of wildland fire risk across Maricopa County, designing mitigation measures and priority needs to implement mitigation measures, whether wildland fire fuel manipulations, resource response, reduced structural ignitibility or public education and outreach.

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 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 Maricopa County CWPP analysis consisted of 3,072,461 acres of federal, state, and private lands. Cumulative risk levels across the Maricopa County CWPP analysis area include 120,252 acres (4%) of high wildland fire risk, 1,749,492 acres (57%) of moderate risk, and 1, 202,717 acres (39%) 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 Maricopa County CWPP communities' recommendations for enhanced wildland fire protection capabilities; public education, information, and outreach; and support for businesses and industries centered on local wood products, woody biomass, and wildland vegetative fuel management.

As part of the community mitigation plan, the Core Teams identified the Maricopa County CWPP administrators—Maricopa County fire chiefs, Maricopa County Department of Emergency Management (MCDEM), TNF, Arizona State Forestry Division (ASFD), and BLM—who will be mutually responsible for implementing and monitoring Maricopa County CWPP action recommendations in coordination with the future-established countywide community CWPP Working Group. Maricopa County CWPP administrators are responsible for ensuring implementation of the Maricopa 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 Maricopa County CWPP, as well as continued coordination with communities outside the analysis area. Maricopa 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 112 wildland treatment management units within 53 sub-WUI designations of the WUI. These treatment units were analyzed and categorized according to potential risk for wildfire. Each unit was also ranked and described along with a recommendation for its preferred treatment type and method. Preferred treatments were recommended for treatment management units identified as high risk. These treatments are designed to meet the fuel reduction and modification objectives of the Maricopa County CWPP.

Section IV. Maricopa County CWPP Priorities: Action Recommendations and Implementation

During the development of the Maricopa 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 Maricopa 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 Maricopa County CWPP will occur. The Maricopa County CWPP administrators are responsible for implementation and monitoring. Implementation begins by securing grants and other funding necessary to execute the action items.

The Maricopa 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 Maricopa County CWPP:

Arizona State Forestry Division

Municipal fire departments and local fire districts

Government officials, emergency managers, and fire chiefs from the following communities:

- Aguila
- Apache Junction
- Avondale
- Buckeye
- Buckeye Valley
- Cave Creek
- Circle City/Morristown
- Carefree
- Chandler
- El Mirage
- Fountain Hills
- Gila Bend
- Glendale
- Gilbert
- Guadalupe
- Goodyear
- Harquahala
- Litchfield Park
- Mesa
- New River
- Peoria
- Phoenix
- Paradise Valley
- Queen Creek
- Rio Verde
- Sunflower
- Scottsdale
- Sun City
- Sun City West
- Sun Lakes
- Surprise
- Tempe
- Tolleson
- Tonopah
- Wickenburg
- Wittmann
- Youngtown

Maricopa County Department of Emergency Management

US Department of the Interior Bureau of Land Management

Tonto National Forest

Fort McDowell Indian Community

Gila River Indian Community

Salt River Pima-Maricopa Indian Community

Tohono O’odham Indian Nation San Lucy District

I. INTRODUCTION

The Maricopa 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 Maricopa County, Arizona (see Figure 1.1), located around public lands administered by the following agencies: the US Department of the Interior Bureau of Land Management (USDI BLM) Phoenix District Office and the Tonto National Forest (TNF) Cave Creek District. 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.

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 by insect or disease epidemics, and critical wildlife habitat that would be negatively affected by a catastrophic wildfire.

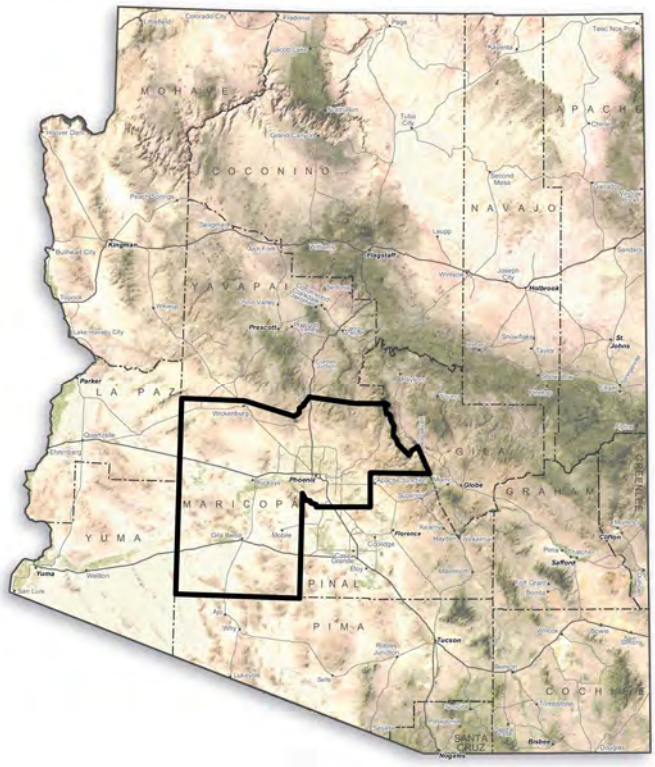

Figure 1.1. Analysis area

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 Maricopa 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 Maricopa 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 Maricopa 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 Maricopa 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); 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 District and TNF to help Maricopa County and the State of Arizona implement the recommendations of Maricopa County and to help the Arizona State Land Department (ASLD); ASFD; TNF; and 44 separate communities, including 27 municipal fire departments, 3 tribal fire departments, and 13 fire districts. Cooperating fire agencies include the Salt River Pima-Maricopa Indian Community and the participating municipal fire departments of Buckeye, Carefree, Cave Creek, Chandler, El Mirage, Glendale, Goodyear, Guadalupe, Gila Bend, Litchfield Park, Paradise Valley, Peoria, Phoenix, Scottsdale, Surprise, Tolleson, Gilbert, and Youngtown. Cooperating municipal fire departments include Avondale, Mesa, Queen Creek, Tempe, and Wickenburg. Participating fire districts include Aguila, Buckeye Valley, Circle City/Morristown, Daisy Mountain, Harquahala, Rio Verde, Sun City, Sun City West, Sun Lakes, Tonopah Valley, and Tonto Hills. Cooperating fire districts include Gilbert County Island and Wittmann. The community of St. Johns is located within the Gila River Indian Community. Additional tribal communities, structures/infrastructures, and recreation areas are included in the Salt River Pima-Maricopa Indian Community, the Fort McDowell Indian Reservation, and the Tohono O'odham Nation San Lucy District analyses; however, they are not presented separately in the Maricopa County CWPP. The community of Sunflower is not located within a fire district. The Maricopa County CWPP also allows these 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 wildfire public education and outreach programs, and improving public and firefighter safety and response capabilities. The Maricopa 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) and the *Southwest Community Wildfire Protection Plan Guide* (Southwest Strategy 2009).

To ensure that all residents of Maricopa 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 Maricopa County located east of Interstate 17 (I-17) and east of Interstate 10 (I-10), and the Western Core Team includes all identified at-risk communities west of I-17 and I-10. The Core Teams agreed to and established an efficient process to be followed throughout the Maricopa County CWPP development. The Core Teams identified 44 communities and analyzed 3,072,461 acres for potential risk from catastrophic wildland fire within Maricopa 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 Maricopa County CWPP. The Core Teams represent all identified at-risk communities and principal developed areas within Maricopa County. As additional guidance documents become available, changes or amendments will be incorporated into the Maricopa County CWPP as necessary.

The following sections detail the background and process used to develop the Maricopa County CWPP and define the associated WUI. In addition, the desired future condition of lands covered by the Maricopa

County CWPP is described; current fire policies and programs are identified; and current projects and future needs are discussed. Finally, the goals of the Maricopa 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 Maricopa County—including tribal trust lands—to identify communities, infrastructure, 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 Maricopa County Department of Emergency Management (MCDEM) requested that local governments, fire departments and districts, BLM, TNF, ASFD, and interested individuals throughout Maricopa County participate in the Core Teams to develop the draft CWPP. Maricopa County is the local government authority for the unincorporated communities identified as at risk, while the city or town councils of the Cities of Avondale, Gilbert, Mesa, Queen Creek, Tempe, and Wickenburg are the appropriate municipal government authorities for cooperating fire departments in developing and agreeing to the Maricopa County CWPP. Maricopa County and the Core Teams recognize the value of conveying information developed from the Maricopa County CWPP process to local citizens. Therefore, the Core Teams provided updates of the Maricopa 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 Maricopa 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 unwanted 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 analyses for the proposed wildland fuel mitigation recommendations, as well as the development of the Maricopa County CWPP, the Core Teams reviewed the following documents:

[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).

- "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 2009a)
- *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)
- *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 4,016 wildfire ignitions have been recorded within the Maricopa County CWPP WUI. Large wildfires have become increasingly common in the desert vegetation zones due to the presence of nonnative annual grasses. In total, 13 large wildfires have occurred in or adjacent to the WUI since 2000, burning over 376,173 acres of wildland habitat within and adjacent to the Maricopa County CWPP WUI. The fire departments and districts within the county have responded to and suppressed numerous wildland fires within the WUI during the past several years. The Core Teams determined that the majority of wildfire starts within the county have occurred within the Gila River riparian corridor from the south border of the San Tan Mountains through the Gila River Indian Community to west of Gila Bend. Additional high-ignition areas include the I-17 corridor from north Phoenix to the community of New River, the SR 87 corridor to the community of Sunflower, and the Verde River corridor, from the confluence of the Verde and Salt rivers north to the WUI boundary. Many of these wildland fire ignitions have occurred within saltcedar-invaded riparian communities and higher-elevation chaparral and woodland vegetation associations that threaten the at-risk communities of Maricopa 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 Maricopa 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. Governor Janice Brewer issued Executive Order 2007-17 re-establishing the Forest Health Council on July 9, 2009. 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 Maricopa 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 Maricopa County communities listed in the *Arizona-Identified Communities at Risk* (Arizona State Forester 2009), as well as other developed areas identified as at risk within the Maricopa County CWPP WUI, constitute interface or intermix communities (see USDA and USDI 2001a; Arizona State Forester 2007) at risk from wildland fire.

B. WUI and Delineation Process

In 2009, five Maricopa County communities (St. Johns, Buckeye Valley, Gila Bend, New River, and Sunflower) were included in the *Arizona-Identified Communities at Risk* (Arizona State Forester 2009) 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 2009), as maintained by the Arizona State Forester. The Core Teams and collaborators recommend maintaining the listing of those 5 communities, based on the results of the Maricopa County CWPP wildland fire analysis, and further recommend including 41 other Maricopa County communities, along with their associated WUI risk ratings, in the *Arizona-Identified Communities at Risk* (Arizona State Forester 2009) (see Table 1.1).

The Maricopa County CWPP analyzes risk and makes recommendations to reduce the potential for unwanted wildland fire to the 44 at-risk communities in Maricopa County, including tribal trust lands. The Maricopa 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 Maricopa 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 Maricopa 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).

Table 1.1. Maricopa County CWPP recommended at-risk communities

Community[a]	WUI risk[b]	Fire department/ district	Community[a]	WUI risk[b]	Fire department/ district
Aguila	L	Aguila Fire District	Paradise Valley	M	Phoenix Fire Department
Apache Junction	M	Apache Junction Fire Department	Peoria	L	Peoria Fire Department
Avondale	M	Avondale Fire Department	Phoenix	L	Phoenix Fire Department
Buckeye	M	Buckeye Fire Department	Queen Creek	M	Queen Creek Fire Department
Buckeye Valley	M	Buckeye Fire District	Rio Verde Corridor	M	Rio Verde Fire District
Carefree	M	Carefree Fire Department*	Salt River Pima-Maricopa Indian Community	M	Salt River Pima-Maricopa Indian Community Fire Department
Cave Creek	M	Rural Metro Fire Department	St. Johns	M	Gila River Indian Community Fire Department
Chandler	L	Chandler Fire Department	Scottsdale	M	Scottsdale Fire Department
Circle City/ Morristown	L	Circle City/Morristown Fire District	Sun City	L	Sun City Fire District
			Sun City West	M	Sun City West Fire District
El Mirage	L	El Mirage Fire Department	Sunflower	H	None
Fort McDowell	L	Fort McDowell Yavapai Indian Reservation	Sun Lakes	L	Sun Lakes Fire District
Fountain Hills	M	Fountain Hills Fire Department*	Surprise	M	Surprise Fire Department
Gila Bend	M	Gila Bend Fire Volunteer Department	Tempe	L	Tempe Fire Department
Gila River Indian Community	M	Gila River Indian Community Fire Department	New River	H	Daisy Mountain Fire District
Gilbert/ Gilbert County Island	L	Gilbert Fire Department	Tonto Hills	M	Tonto Hills Volunteer Fire Department and Rural Metro Fire Department
Glendale	L	Glendale Fire Department	Tolleson	L	Tolleson Fire Department
Goodyear	M	Goodyear Fire Department	Tonopah Valley	L	Tonopah Fire District
Guadalupe	L	Guadalupe Fire Department	Wickenburg	M	Wickenburg Fire Department
Harquahala	L	Harquahala Fire District	Wittmann	L	Wittmann Fire District
Litchfield Park	L	Litchfield Park Fire Department*	Youngtown	L	Youngtown Fire Department
Mesa	L	Mesa Fire Department			
Mobile	L	Good Year Fire Department and Maricopa Fire Department**			

[a] St. Johns, Buckeye Valley, Gila Bend, and New River are listed as moderate and Sunflower is listed as low on the 2009 *Arizona Communities at Risk Matrix* (www.azsf.az.gov).

[b] L=Low, M=Moderate, H=High wildland fire risk

* Through agreement with Rural Metro Fire Department.

** By automatic-aid agreement with City of Goodyear.

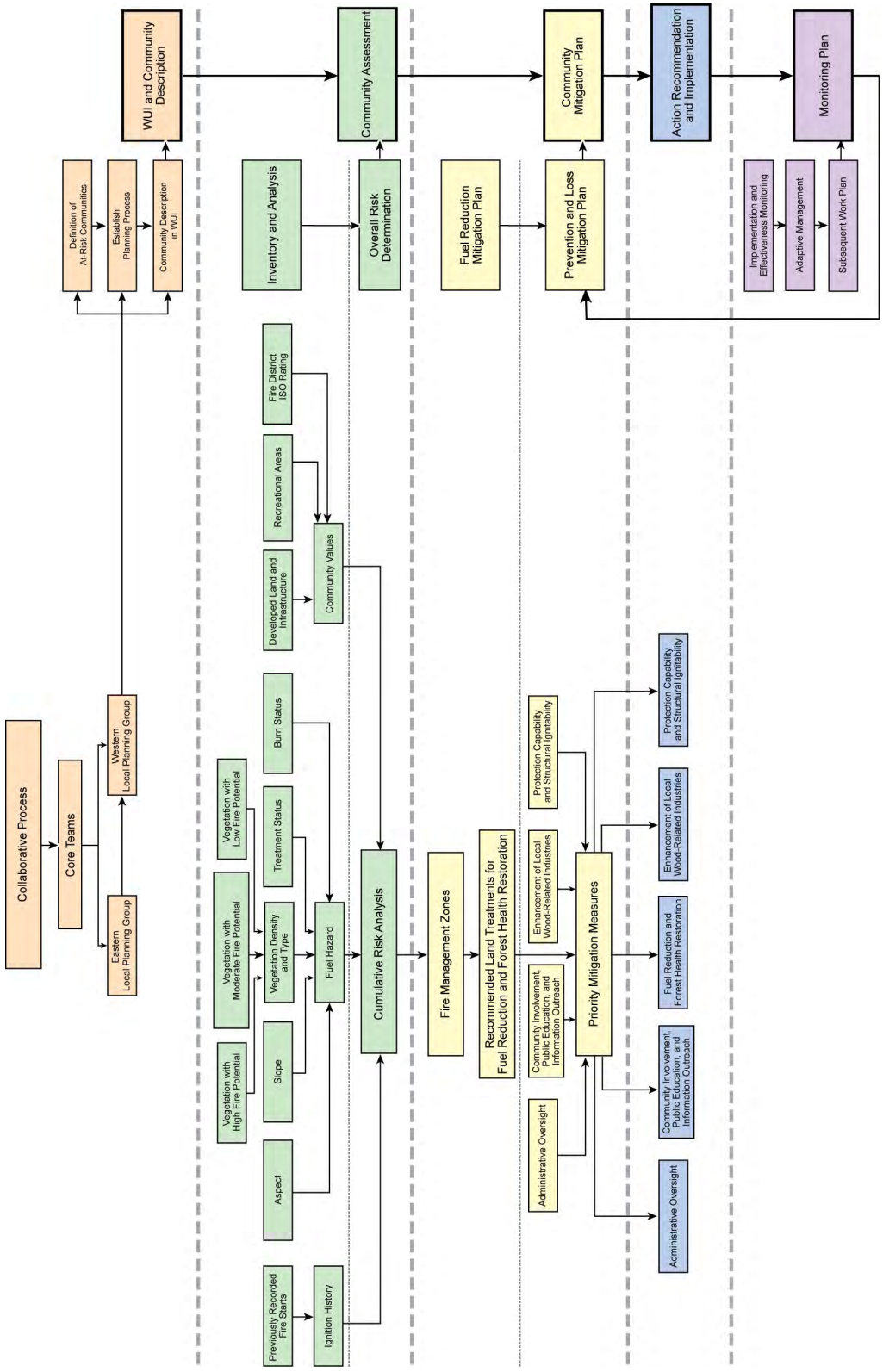

Figure 1.2. Maricopa County CWPP process

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

> 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 Maricopa 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 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 Maricopa 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 Maricopa 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 3,103,370 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. Wildland fire in Maricopa County
(courtesy of Avondale Fire Department)

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

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

C. Desired Future Condition and Wildfire Mitigation in the WUI

The desired future condition of Maricopa 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 Maricopa County. This historical plant potential community is composed of desert scrublands, shrublands (mesquite uplands), riparian corridors, and semidesert grasslands; all of these plant communities have an associated understory of grasses and shrubs, and some are also composed of invasive grasses and woody species (NatureServe 2004; Gori and Enquist 2003). The Core Teams intend the Maricopa County CWPP to complement BLM and TNF objectives; 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); and *Amendment 25 to the Tonto National Forest Land and Resource Management Plan* (USDA FS 2006). 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 both sustain habitat health and meet Maricopa County CWPP management goals while providing for community protection from unwanted wildland fire. Public education and land treatment projects in the Maricopa County CWPP area, coupled with current efforts of local governments, fire departments and districts, TNF, 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, and TNF, which are the federal governing agencies for the public lands associated with the Maricopa County CWPP planning area. BLM and TNF 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 BLM and TNF 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 field offices and the TNF's Cave Creek District. The Salt River Pima-Maricopa Indian Community (SRPMIC) is a compact tribe and manages its own wildland fire program. The SRPMIC Fire Department manages and funds all the equipment and staff, cross-utilizing the resources for the delivery of other emergency services.

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 the northern and eastern portions of the analysis area, the majority 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 the National Firewise Communities program (www.Firewise.org) or to meet home-ignition-zone landscaping or fire-safe landscaping recommended by the Maricopa County CWPP fire departments and districts in compliance with local ordinances. Firewise 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 Maricopa County would like to make this

information available to their citizens and to encourage its application. For example, after making modifications to include high-desert fuel evaluations and construction as being Firewise eligible, Ancala West development in the city of Scottsdale was recognized as the first Firewise community in Maricopa County. 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 Maricopa 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).

Financial commitments required to reduce the risk of catastrophic wildfire can be extensive for municipal, county, state, and federal governments; for fire districts; and for the small rural communities surrounded by public lands. Maricopa County, TNF, and BLM have implemented wildland fuel mitigation projects within or near the Maricopa County CWPP 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. Maricopa County fire departments and districts have standing automatic aid agreements allowing for closest resources to provide initial attack response. The Fire Departments and Districts of Maricopa County maintain wildland fire response teams supported by various engines and support equipment including 57 ambulances, 43 brush trucks, 155 fire engines, 33 ladder trucks, and5 Heavy Rescue vehicles, and various other specialized response vehicles to help suppress wildland fires. 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, and TNF 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 Maricopa 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 Maricopa 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
- Use the CWPP in conjunction 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 2009)
- *Identifying Arizona's Wildland/Urban Interface Communities at Risk: A Guide for State and Federal Land Managers* (Arizona State Forester 2007)
- *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)
- *Tonto National Forest Land and Resource Management Plan* (USDA FS 2005)
- *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)

- *Strategic Plan 2007-2012* (Central Arizona Wildland Response Team 2007)
- *Wildland Fire Use Implementation Procedures Reference Guide* (USDI and USDA 2005)
- *Guidance for Implementation of Federal Wildland Fire Management Policy* (USDA and USDI 2009)
- *Maricopa County Multi-Jurisdictional Hazard Mitigation Plan* (MCDEM and JE Fuller 2009)
- *McDowell Sonoran Preserve Fire and Emergency Response Plan* (City of Scottsdale Fire Department 2010)

Action recommendations for at-risk areas within the Maricopa 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 Maricopa 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 Maricopa County CWPP comply with applicable local, state, and federal environmental regulations. The dedication of the Core Teams and collaborators in implementing the Maricopa County CWPP assures that all agencies, groups, and individuals involved will develop any additional formal agreements necessary to ensure the Maricopa 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 Maricopa County communities, with all parties being involved and being committed to the development and implementation of the Maricopa County CWPP.

II. Maricopa County CWPP Community Assessment and Analysis

The community risk assessment is an analysis of the potential for catastrophic wildland fire to Maricopa County communities and lands within the WUI identified by the Core Teams. This risk analysis incorporates the current fire regime-condition class, wildfire fuel hazards, risk of ignition, local preparedness and protection capabilities, and at-risk community values. 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* (2007) to ensure that the Maricopa 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, local preparedness, and protection capabilities and loss of community values are evaluated to determine areas of highest wildland fire risk.

The Maricopa County CWPP planning area includes all of Maricopa 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 (Figures 2.1a and 2.1b). Gila River, Fort McDowell, Gila Bend, and Salt River Pima-Maricopa tribal trust lands are included in the total acreage of the WUI. The Maricopa County CWPP comprises 3,103,370 acres of land (Table 2.1).

Table 2.1. Land management within the WUI

Ownership type	Total acres	% of total
Barry M. Goldwater Air Force Range	6,456	0
BLM	465,326	15
Bureau of Reclamation	18,495	1
Maricopa County land	6,387	0
Fort McDowell Indian Reservation	24,869	1
Arizona Game and Fish Department	5,396	0
Gila Bend Indian Reservation	408	0
Tohono O'odham Nation San Lucy District	160,802	5
Hohokam Pima National Monument	626	0
Luke Air Force Base	2,823	0
Military Reservation	1,803	0
Painted Rock Wildlife Area	5,056	0
Private land	1,715,540	55
Salt River Pima-Maricopa Indian Reservation	53,711	2
State Trust land	445,061	14
TNF	90,040	3
Williams Air Force Base	2	0

Continued

Table 2.1. Land management within the WUI

Ownership type	Total acres	% of total
Buckeye Hills Regional Park	4,441	0
South Mountain Regional Park	15,677	1
Estrella Mountain Regional Park	18,531	1
White Tank Mountain Regional Park	29,195	1
McDowell Mountain Regional Park	21,076	1
Cave Creek Regional Park	2,763	0
Parks and recreation	397	0
Parks and recreation (other)	8,491	0
Total	3,072,461	100

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

The Maricopa County CWPP planning area primarily includes private (55 percent), BLM (15 percent), ASLD (14 percent), and TNF (3 percent) lands.

Primary land ownership in the Maricopa County CWPP planning area is a mosaic of privately owned lands and lands administered by the BLM and ASLD (Table 2.1 and Figures 2.1a and 2.1b). Much of the land within the Maricopa County CWPP planning area is urban with associated adjacent urban development in proximity to undeveloped public and state lands (such as Anthem) and rural communities with minimal development (such as New River and Sunflower).

Of the publicly owned lands within the WUI, BLM is the largest land manager with 465,326 acres, or 15 percent of lands, located throughout the WUI. State Trust 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 State Trust lands to produce revenue for the Arizona State Trust beneficiaries, including the state's school system. Within the Maricopa 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, TNF lands compose 90,040 acres, or approximately 3 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 Maricopa County CWPP area.

Private land within the WUI composes the largest ownership within the WUI at 1,715,540 acres, or roughly 55 percent, of the WUI. Private lands are mostly clustered near the communities, with some scattered private inholdings located throughout the WUI. The municipalities/unincorporated communities of Phoenix, Scottsdale, Goodyear, Surprise, El Mirage, Glendale, Apache Junction, Queen Creek, Paradise Valley, Sun Lakes, Guadalupe, Mesa, Tempe, Fountain Hills, Gilbert, Salt River Pima-Maricopa Indian Community, Sun City, Sun City West, Buckeye, Gila Bend, Wickenburg, Avondale, Chandler, Tolleson, Litchfield Park, Youngtown, Carefree, Cave Creek, Circle City/Morristown, and New River contain

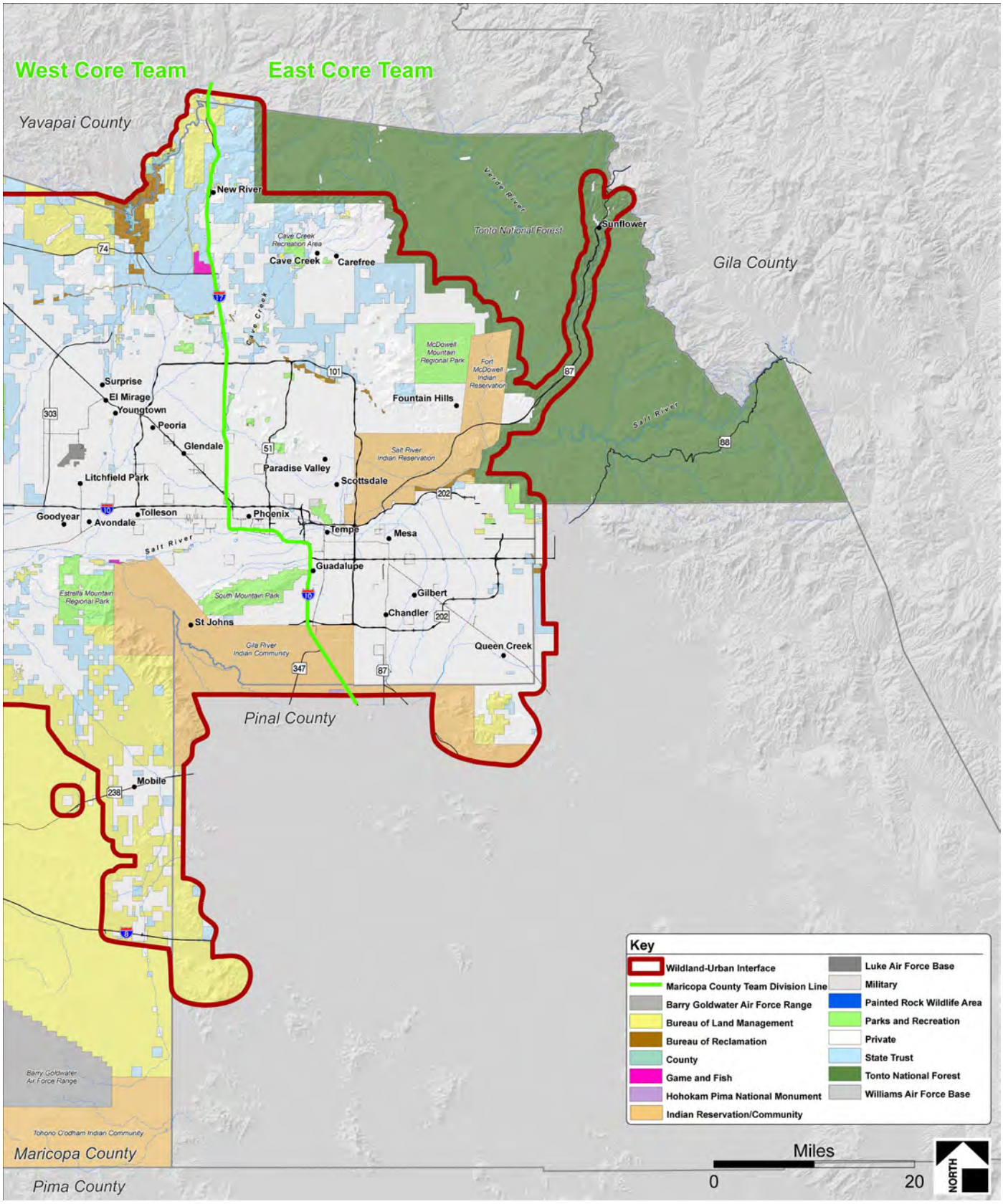

Figure 2.1a. Maricopa County CWPP WUI area, east

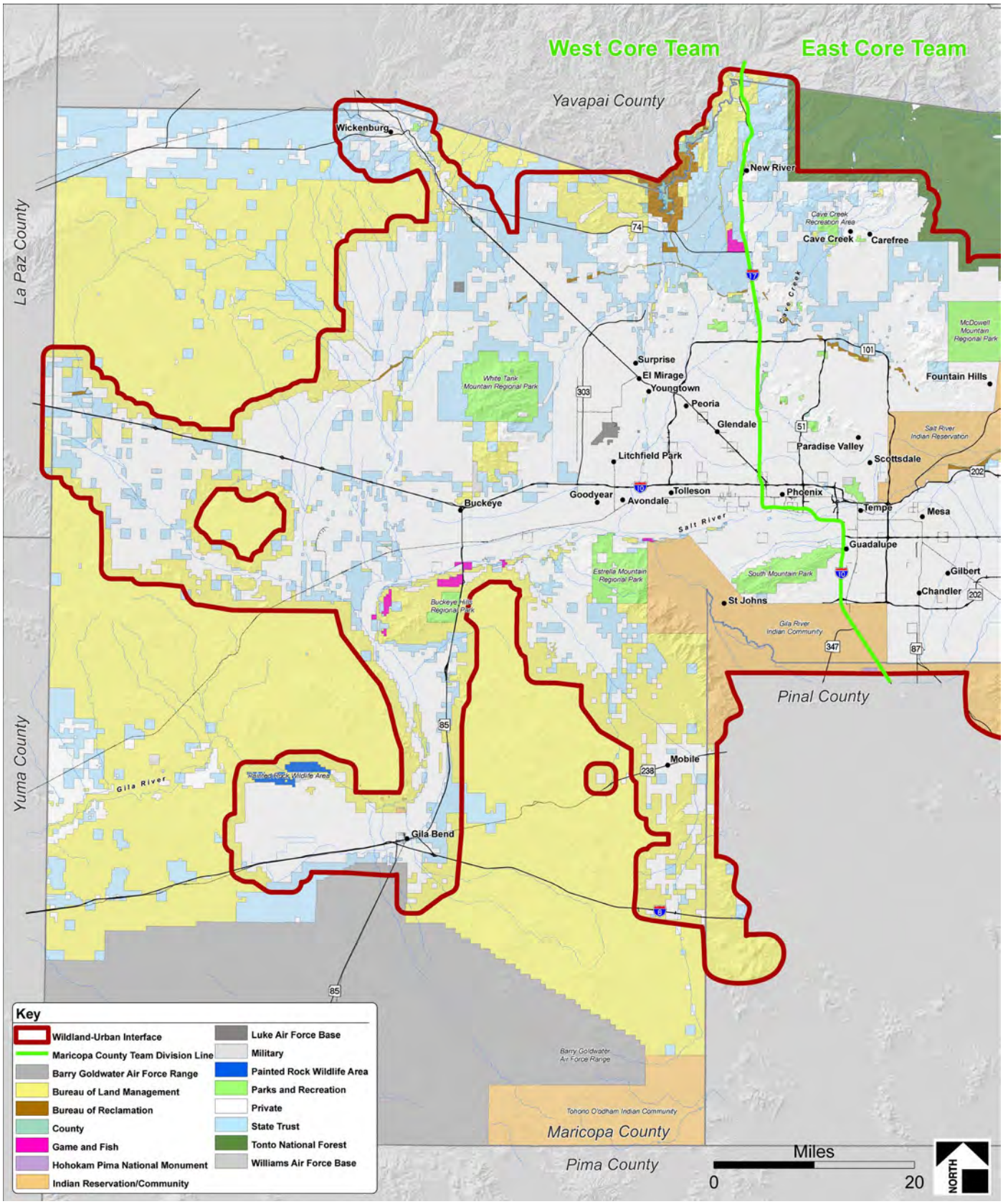

Figure 2.1b. Maricopa County CWPP WUI area, west

the majority of private land acreage within the WUI. 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 Maricopa County at-risk communities.

Maricopa County has experienced considerable growth in population and housing during the recent decade. The population estimate for Maricopa County was reported as approximately 3,862,036 with slightly over 1,536,471 housing units, in 2008—this represents a 22 percent increase in housing units since the 2000 census (US Census Bureau 2009). Growth is anticipated to continue in both urban and rural settings in Maricopa County. Maricopa 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 Maricopa County CWPP planning area boundary is identified in Figures 2.1a and 2.1b 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. A portion of one of these identified forested landscapes, the Sky Islands, occurs in Maricopa 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 for Restoring Arizona's Forests* is circumscribed by the Gila Mountains to the north, the Baboquivari Mountains to the west, and the Mexican border to the south. The Eastern Core Team reviewed the current conditions and future restoration needs of the Four Peaks Wilderness area, within the Sky Islands landscape, to ensure that the Maricopa County CWPP is complementary to the recommendations of the *Statewide Strategy for Restoring Arizona's Forests.* Landscape vegetation ranges from madrean encinal to oak woodlands at elevations normally above 3,600 feet to desert shrublands at lower elevations. Due to high levels of topographical complexity and gradient within the portion of the Sky Islands landscape within the Maricopa 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 2007:115) of the Sky Islands landscape applicable to the Maricopa 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 Maricopa 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 Maricopa County CWPP to be complementary to those assessments and recommendations.

The climate of Maricopa County is varied—ranging from semiarid desert shrub-scrub vegetative associations with relatively low precipitation, low humidity, and high summer temperatures; to vegetative communities associated with the Gila, Salt, Verde, Agua Fria, and Hassayampa rivers and riparian corridors of New River, Sycamore, and Cave creeks; and to oak and pinyon-juniper woodlands with mild

summers and cool winters. Precipitation averages from 3.5 to 37.0 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. The average annual air temperature is 47 to 74 degrees Fahrenheit. The freeze free period averages from 255 to 285 days, decreasing in length with increasing elevation (NRSC 2010a and 2010b).

The planning area includes the Gila, Salt, Verde, Agua Fria, and Hassayampa rivers. The Verde River is a tributary to the Salt River. The Salt, Agua Fria, and Hassayampa rivers are all direct tributaries of the Gila River. The Gila River has its source in western New Mexico. It flows into Arizona, past the town of Safford, and along the southern slope of the Gila Mountains in Graham County. It emerges from the mountains into the valley southeast of Phoenix, where it crosses the Tohono O'odham Nation San Lucy District as an intermittent stream due to large irrigation diversions. West of Phoenix, the river bends sharply southward along the Gila Bend Mountains and then turns sharply westward near the town of Gila Bend. It then flows southwestward through the Gila Mountains in Yuma County, and finally it flows into the Colorado River at Yuma.

The Salt River is formed in eastern Arizona in eastern Gila County, by the confluence of the White and Black rivers. It flows northwest through Salt River Canyon, then southwest and west through the Tonto National Forest. It passes through the valley between the Mazatzal Mountains and Superstition Mountains, past Man Island, and supplies several consecutive reservoirs: Lake Roosevelt, Apache Lake, Canyon Lake, and Saguaro Lake. Near Fountain Hills it is joined by the Verde River. About five miles downstream of this point, the Granite Reef Diversion Dam diverts all remaining water into the Arizona and South canals, which deliver drinking and irrigation water to much of the Phoenix metropolitan area. The Salt River joins the Gila on the southwestern edge of Phoenix approximately 15 miles from the center of the city.

The head of the Verde River begins below the dam that catches water from the Big Chino Wash and Williamson Valley Wash combining to create Sullivan Lake in Yavapai County. This occurs during periods of sufficient precipitation. The Verde flows freely above- and belowground for 125 miles through private, state, tribal, and USDA Forest Service lands, specifically the TNF, before encountering the first of two dams that make Horseshoe Lake and Bartlett Lake. The Verde River converges with the Salt River near Fountain Hills.

The Agua Fria River is a 120-mile-long intermittent stream that flows generally south from 20 miles east-northeast of Prescott. Prescott draws much of its municipal water supply from the upper Agua Fria drainage. The Agua Fria runs through the Agua Fria National Monument and then flows through Black Canyon into Lake Pleasant. When flows are sufficient, the Agua Fria River flows into the Gila River. The Hassayampa River is a mostly underground river in Arizona. However, the river flows aboveground within the Hassayampa River Canyon Wilderness. The Hassayampa converges with the Gila River near the Buckeye Hills.

The majority of federally managed public lands within the Maricopa 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 are administered by the TNF and consist of four fire management units (FMUs): FMU 1–Desert, FMU 4–Woodland Brush, FMU 5–Wilderness, and FMU 6–WUI9 (USDA FS 2005) 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 Four Peaks and Mazatzal 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 (2007:3):

> 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 Maricopa County WUI covers 3,072,461 acres, including 633,059 acres of land classified as developed and low-density open space and barren landscape (21% of WUI acres) and 377,229 acres of agricultural land (12% of WUI acres). The WUI includes 1,923,633 acres (63% of WUI acres) of Fire Regime Condition Class (FRCC) I lands, 137,526 acres (4% of WUI acres) of FRCC II lands, and 1,014 acres (<0.01% 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 2005a, 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, red brome, and Mediterranean grass) 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 may actually fall within Condition Classes 2 and 3.

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 Maricopa 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* (2005b):

> 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, Interior Chaparral, Upland and Lower Sonoran Desert Scrub, Semidesert Grassland, 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:

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.

Interior Chaparral:

Wildfire naturally maintains shrub cover while reducing annual grass cover, the invasion of woody plants such as juniper and pinyon pine are controlled and the average age of chaparral stands is reduced through controlled fire or mechanical treatment.

Upland Sonoran Desert Scrub

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.

Lower Sonoran Desert Scrub:

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.

Semidesert Grassland:

Perennial grasses cover its historic range of variability, annual grass cover is reduced and fire naturally inhibits the invasion of woody plants such as juniper, tarbush, whitethorn and creosotebush.

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 (such as mesquite and juniper species) and nonnative grasses (such as buffelgrass, 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) (Figures 2.2a and 2.2b). 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 Maricopa County CWPP vegetation association were field verified.

The existing arrangement and flammability of vegetation associations largely determine wildland fire behavior. Flammability for the Maricopa County WUI is mapped in Figures 2.3a and 2.3b. 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 Scott and Burgan 2005) and vegetation fuel fire-risk rating within the Maricopa County CWPP WUI are shown in Table 2.3. As described by the Arizona State Forester (2007:1),

> **"EVALUATE RISK TO COMMUNITIES:** 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."

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	Creosotebush, mixed desert, and thorn scrub	L	1,2	T	4–6	4	2310–5150 (35–78)	GR1 GR2	0.5–1.7 1.0–8.0	GR1: 1 GR2: 1–4	0–990 (0–15) 0–7920 (0–15)	85 (<1)
	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 GR2, 1.0–8.0	GR1, 1 GR2, 1–4	GR1, 0–990 (0–15) GR2, 0–7920 (0–120)	878,028 (29)
	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 SH1, 0.2–0.7	GR1, 1 SH1, 1	GR1, 0–990 (0–15) SH1, 6.6–112.2 (0.1–1.7)	1,040,664 (34)
	Mixed-desert scrub	L	1,2	L and T	4–6	3	2310–5150 (35–78)	GR1 or GR2	GR1, 0.5–1.7 GR2, 1.0–8.0	GR1, 1 GR2, 1–4	GR1, 0–990 (0–15) GR2, 0–7920 (0–120)	58,368 (2)

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 (%)
Shrublands	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 GS1, 1.0– 6.0 SH1, 0.2–0.7 SH2, 1.0–4.5 SH5, 4.0–25.0+	GR1, 1 GS1, 1–3 SH1, 1 SH2, 1–3 SH5, 2–6	GR1, 0–990 (0–15) GS1, 0–3960 (0–60) SH1, 6.6–112.2 (0.1–1.7) SH2, 0–1188 (0–18) SH5, 0–16,500 (0–250+)	16,186 (1)
Grasslands	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 GR1, 0.5–1.7 GR2, 1.0–8.0	GS1, 1–3 GR1, 1 GR2, 1–4	GS1, 0–3960 (0–60) GR1, 0–990 (0–15) GR2, 0–7920 (0–120)	42 (<1)
Woodlands	Chaparral	H	4, 6	B and T	6–19	4–6	2110–4950 (32–75)	SH2 or SH5	SH2, 1.0–4.5 SH5, 4.0–25.0+	SH2, 1–3 SH5, 2–6	SH2, 0–1188 (0–18) SH5, 0–16,500 (0–250+)	6,900 (<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 (%)
	Encinal Oak Woodland	M	1,3	B and T	2.6–6	4	495–2310 (7.5–35)	GR2, GR4, or TL1	GR2, 1.0–8.0 GR4, 2.0–21+ TL1, 0.25–0.5	GR2, 1–4 GR4, 1–6 TL1, 1	GR2, 0–7920 (0–120) GR4, 0–33000 (0–500+) TL1, 6.6–46.2 (0.1–0.7)	7 (<1)
	Pinyon-juniper Woodland	H	2,3	F	6-19	4-6	2110-4950 (32-75)	GR1, SH2, SH5, SH6, TU3	GR1, 0.5–1.7 SH2, 1.0–4.5 SH5, 4-25+ SH6, 3-15 TU3, 2-16	GR1-1 SH2, 1–3 SH5, 2-6 SH6, 5-6 TU3, 2-6	GR1, 0–990 (0–15) SH2, 0–1188 (0–18) SH5, 0–16500 (0–250+) SH6, 0-7260 (0-110) TU3, 0-10560 (0-160)	4,570 (<1)
	Pine-oak Forest and Woodland	M	2,9	F and E	2.6-8	4-5	495-2310 (7.5-35)	SH8, TU3, TL3	SH8, 2-22 TU3, 2-16 TL3, 0.4-1.3	SH8,2-6 TU3, 2-6 TL3, 1-2	SH8, 0-7260 (0-110) TU3, 0-10560 (0-160) TL3 0-198 (0-3)	1,572 (<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 (%)
	Juniper savanna	M	2,6	F	6-8	4	2110-2310 (32-75)	GR1, SH2, SH5, SH6, TU1	GR1, 1.0–6.0 SH2, 1.0–4.5 SH5, 4-25+ SH6, 3-15 TU1, 1-4	GR1, 1 SH2, 1–3 SH5, 2-6 SH6, 5-6 TU1, 2-3	GR1, 0–990 (0–15) SH2, 0–1188 (0–18) SH5, 0–16500 (0–250+) SH6, 0-7260 (0-110) TU1, 0-990 (0-15)	213 (<1)
	Ponderosa Pine Woodland	H	2,9	E and T	2.6->8	4-5	495-2310 (7.5-35)	TU5, TL8	TU5, 2-14 TL8, 1-8	TU5, 6 TL8, 4	TU5, 0-2,772 (0-42) TK8, 0-2,640 (0-40)	125 (<1)
Deciduous Southwest Riparian	North American Warm Desert Riparian Mesquite Bosque	H	6,9	E and T	2.6–12	6	495–2110 (7.5–32)	SH2, SH5, or TL2	SH2, 1.0–4.5 SH5, 4.0–25.0+ TL2, 0.3–1.0	SH2, 1–3 SH5, 2–6 TL2, 1	SH2, 0–1188 (0–18) SH5, 0–16,500 (0–250+) TL2, 13.2–132 (0.2–2.0)	15,262 (<1)
	Invasive Southwest Riparian Woodland and Shrub	H	4	G and T	19	6	4950 (75)	SH2,SH5	SH2, 1.0-4.5 SH5, 4.5-25+	SH2, 1-3 SH5, 2-6	SH2, 0-1188 (0-18) SH5, 0-16,500 (0-250)	11,163 (<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 (%)
	Riparian Woodland and Shrubland	H	8 and 9	E and T	2.6-6	4-6	495-2110 (7.5-32)	SH2, SH4	SH2, 1.0-4.5 SH4, 1.0-16	SH2, 1-3 SH4, 2-6	SH2, 0-1188 (0-18) SH4, 0-11,550 (0-175)	13,032 (<1)
Other	Agriculture	L	NA	NA	NA	NA	NA	NB3	NA	NA	NA	377,641 (12)
	Developed, Open Space–Low Intensity	L	NA	NA	NA	NA	NA	NB1	NA	NA	NA	119,430 (4)
	Developed, Medium–High Intensity	L	NA	NA	NA	NA	NA	NB1	NA	NA	NA	515,175 (17)
	Barren Lands, Non-Specific	L	NA	NA	NA	NA	NA	NB9	NA	NA	NA	2,974 (<1)
	Volcanic Rock land and Cinder land	L	NA	NA	NA	NA	NA	NB9	NA	NA	NA	21 (<1)
	Recently mined or quarried	L	NA	NA	NA	NA	NA	NB9	NA	NA	NA	328 (<1)
	Open water	L	NA	NA	NA	NA	NA	NB9	NA	NA	NA	10673 (<1)
											Total	3,072,461

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.

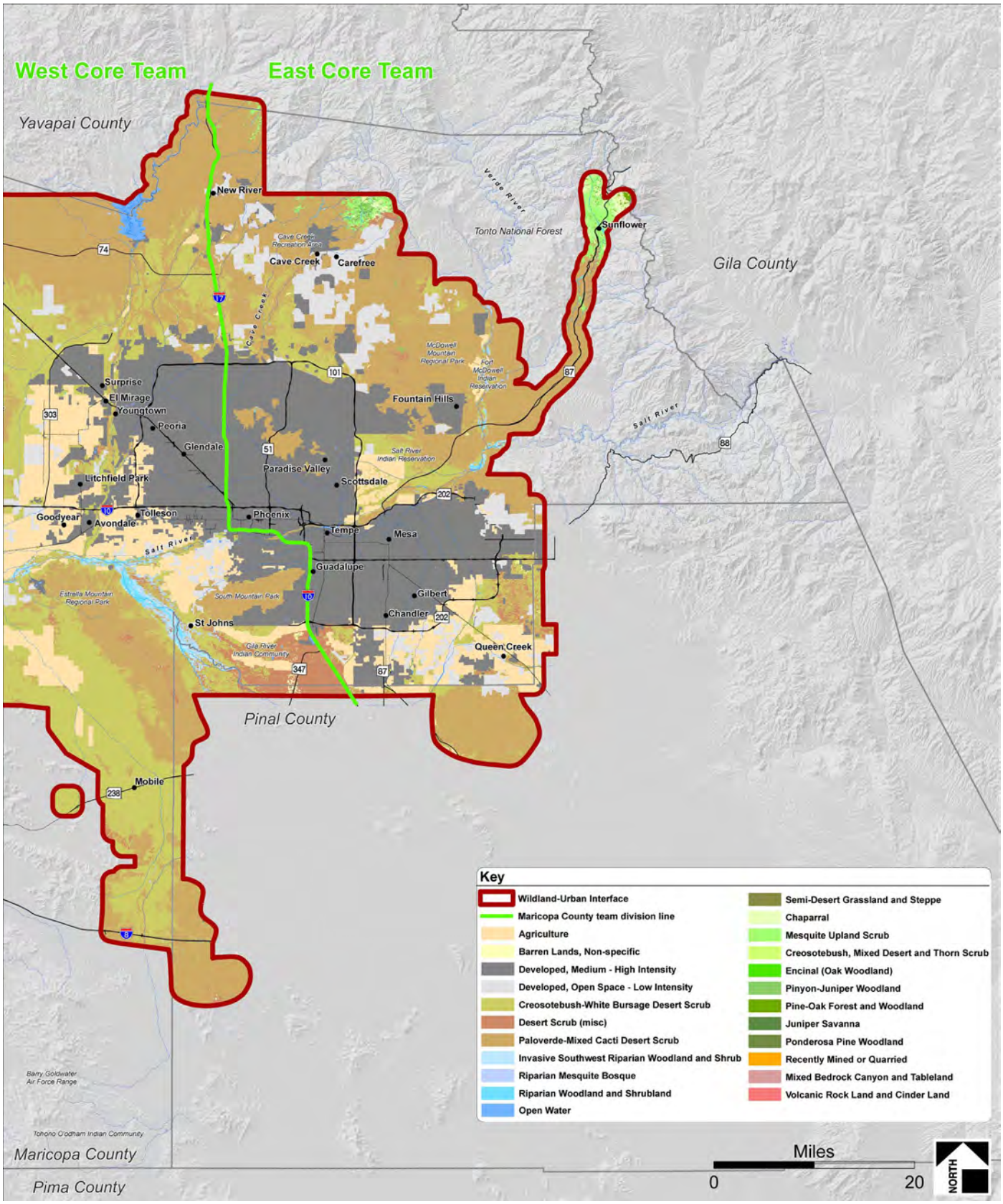

Figure 2.2a. Maricopa County CWPP vegetation associations, east

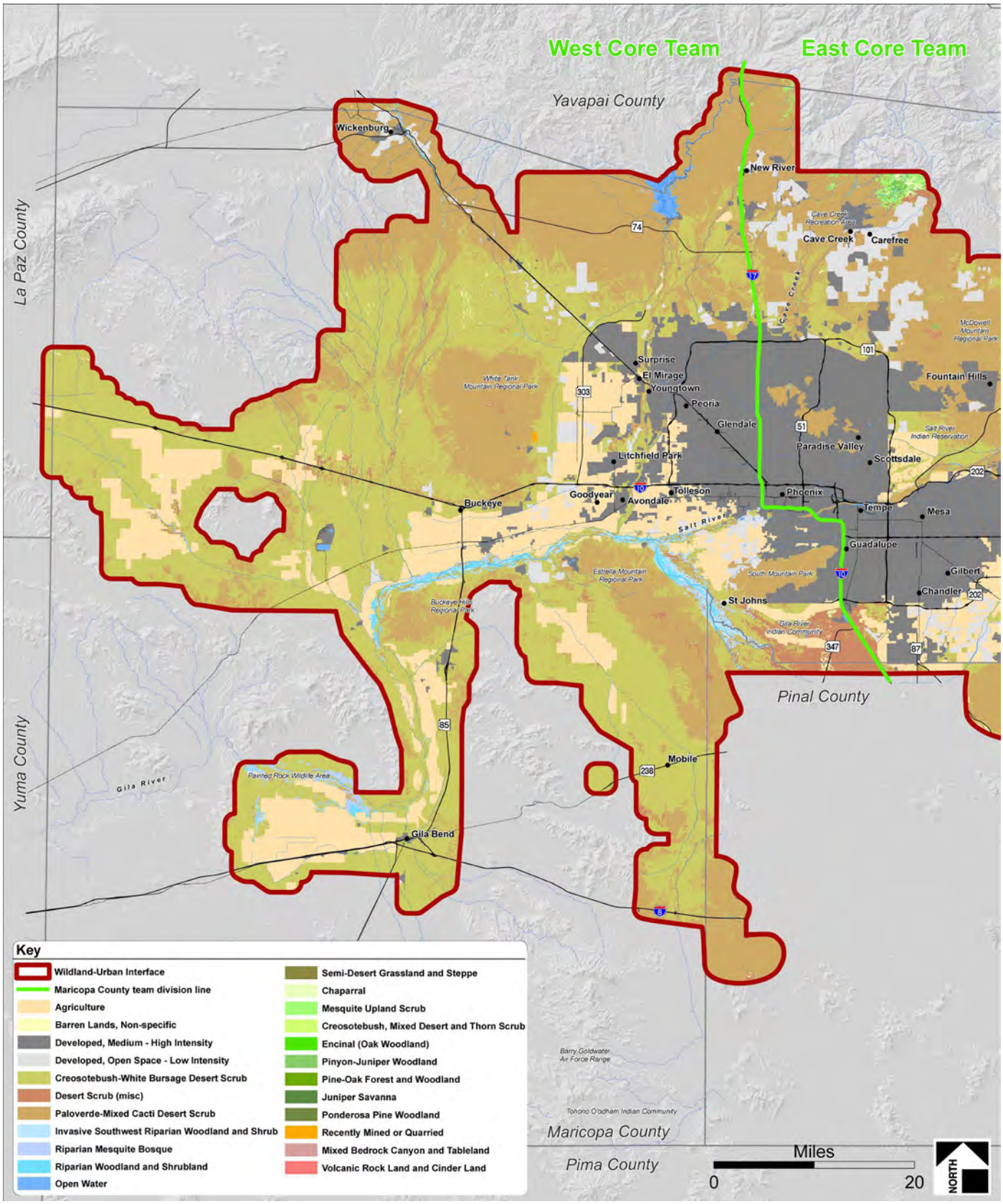

Figure 2.2b. Maricopa County CWPP vegetation associations, west

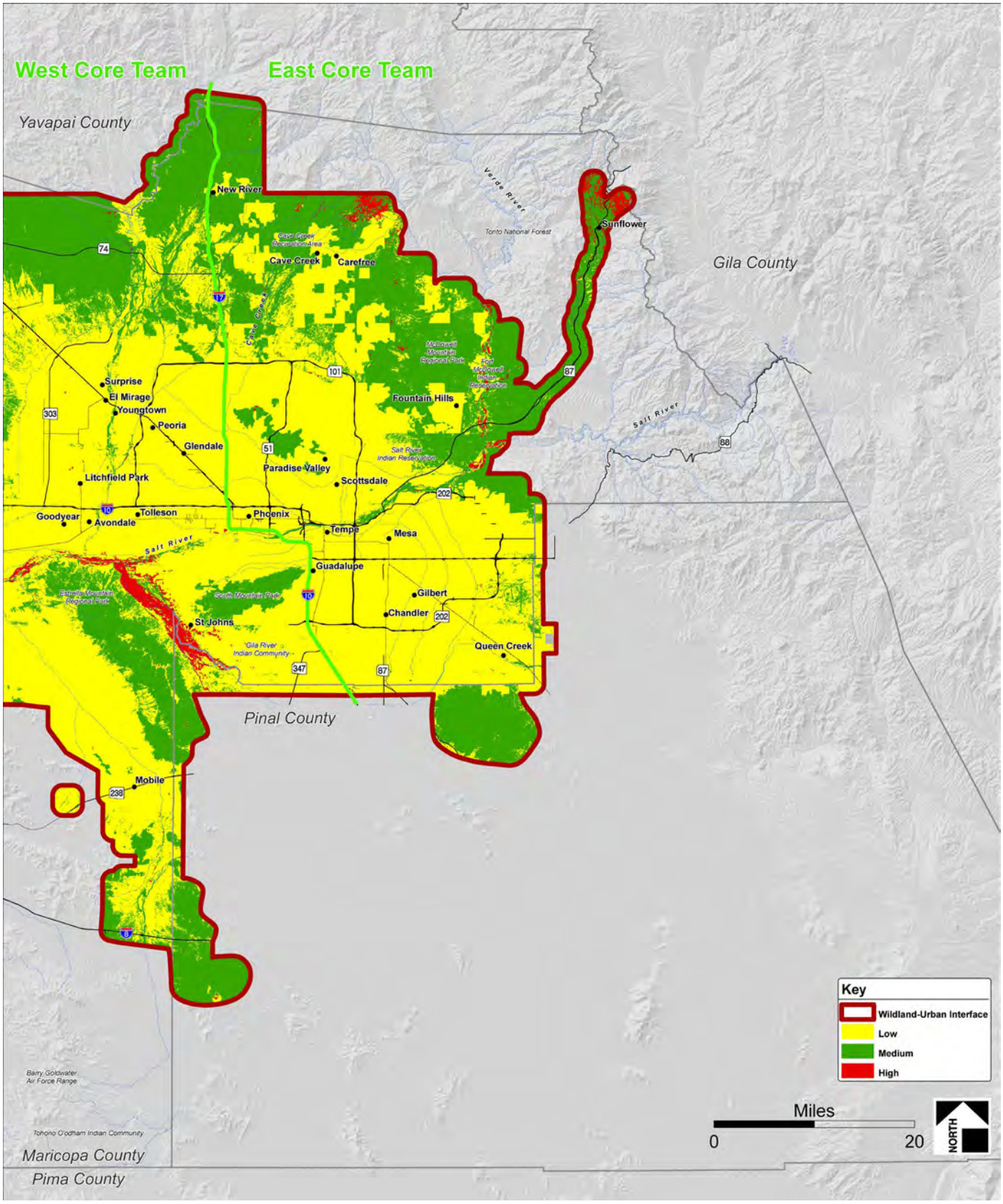

Figure 2.3a. Maricopa County CWPP flammability, east

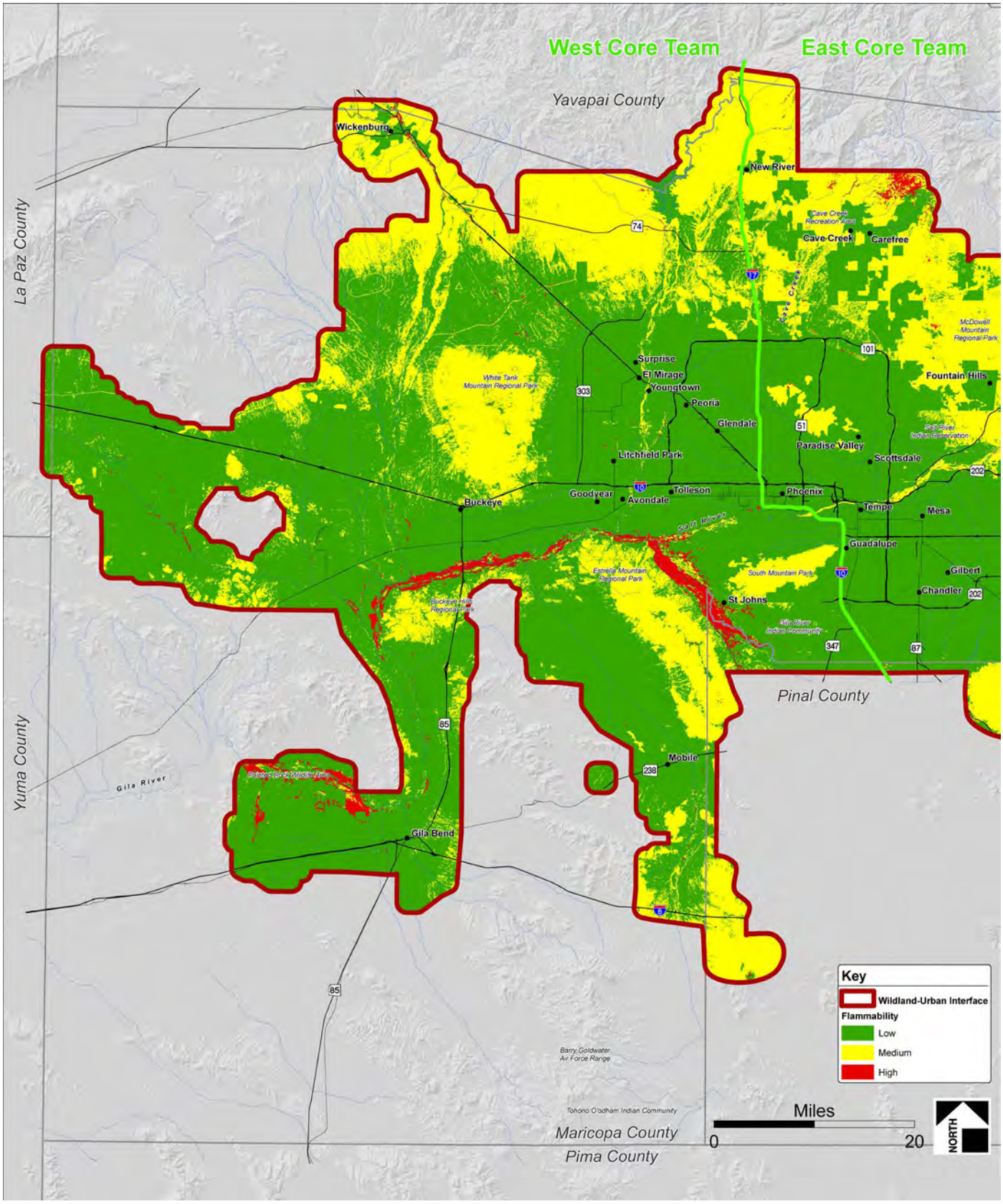

Figure 2.3b. Maricopa County CWPP flammability, west

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 (2007:1–2):

> 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.

Maricopa County is composed of two major land resource areas (MLRAs) (Natural Resources Conservation Service [NRCS] 2007, 2010a, 2010b): Sonoran Basin and Range and Mogollon Transition. The Sonoran Basin and Range region is in the Sonoran Desert section of the Basin and Range province of the Intermontane Plateaus and is characterized by many short, fault-block mountain ranges trending southeast to northeast that rise abruptly from the smooth, gently sloping desert valley floors. Elevation ranges from 980 to 3600 feet in most areas, with mountains reaching 4590 feet. The Mogollon Transition region is within the Mexican Highland Section of the Basin and Range Province of the Intermontane Plateaus. The area is characterized by canyons and structural troughs and valleys with elevations ranging from 3000 to 5500 feet in most areas with mountains reaching 5100 to 7500 feet.

Vegetative production within these MLRAs 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 16 major vegetation associations (including agricultural lands), 3 mostly nonvegetation associations, and 2 open-space residential developed land covers, as well as open water (NatureServe 2004). These different vegetative communities are listed and described in Appendix A. Each vegetative community is assigned to an array of fuel models 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 2005b), 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.

1. Vegetation Associations

The Desert Shrub-Scrub vegetation association is the largest natural land cover within the WUI; it occurs on drier upland sites and includes areas of bare ground and rock habitats supporting a variety of grass, herbaceous, scrub, and shrub species (Photo 2.1). This major vegetative fuel type ranges from lower desertscrub-creosotebush-bursage associations to mixed desert scrub types to paloverde-mixed cacti desertscrub association. The Desert Shrub-Scrub association constitutes 1,977,145 acres (65 percent) of the WUI. During normal rainfall years and the typical fire season, the majority of the lowest-elevation associations (mixed desert scrub and creosotebush-white bursage associations) do not support high-intensity wildfires with high rates of spread, and many wildfires self-extinguish from 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, Mediterranean grass, red brome, and mustards), can produce areas with the potential for extreme rates of spread and enough intensity to ignite overstory vegetation.

Photo 2.1. Desert Shrub-Scrub association

The Shrublands vegetation association includes the mesquite upland scrub and is the largest naturally occurring upland vegetative type within the WUI, accounting for 16,186 acres (0.5 percent of the WUI) (Photo 2.2). 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 2.2. Shrublands association

The Woodland vegetative fuel type (Photo 2.3) includes the chaparral, pinyon-juniper, pine oak, juniper savannas, encinal oak woodlands, and ponderosa pine woodland associations. This fuel type covers 13,387 acres of the WUI (0.4 percent of all WUI acres) and is the second largest upland vegetative fuel type within the WUI. A major vegetative association of shrubland fuel types includes Mogollon chaparral. This ecological system occurs across central Arizona, western New Mexico, southwestern Utah, and southeast Nevada. It often dominates 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 2.3. Woodland association

Encinal oak woodlands occur 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, sometimes, desertscrub. Common evergreen oak species include oaks, and chaparral species. The graminoid layer usually prominent between trees is grassland or steppe that is dominated by warm-season grasses typical of semidesert grasslands. This association can also be composed of stands dominated by shrubby Madrean oaks, typically with a strong graminoid layer and, in some instances, invasive grasses and forbs. In transition areas with drier 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, Southwest invasive riparian woodland and shrub, and riparian woodland and shrubland associations. This vegetative association covers 39,457 acres and is the second largest vegetative association within the WUI (1.3% of all WUI lands). The Maricopa County WUI includes the riparian corridors of the Gila, Verde, Salt, Hassayampa, and Agua Fria rivers. 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, and dominant 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 2.4). 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, higher human-caused 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 2005b: PNVG Code RIPA).

Photo 2.4. Deciduous Southwest Riparian association

The desert grassland fuel type is primarily represented by the semi-desert grassland and steppe association. This is the smallest of the naturally occurring vegetative association, covering only 42 acres (less than .002 percent) 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 it 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.

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 634,605 acres (20 percent) 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 2.5). However, private lands within the WUI account for approximately 55 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. 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 areas. 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 2.5. 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 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 southerly 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), as well as annual grasses and forbs, can result in more continuous fine fuel cover. This change in fine-fuel continuity can result in faster rates of spread and increased intensity levels in desert shrub-scrub and shrubland habitats 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) and will, under these extraordinary circumstances, become areas of extremely high wildfire risk.

Figures 2.4a and 2.4b 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, 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 decade. 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 Figures 2.5a and 2.5b.

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, and 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

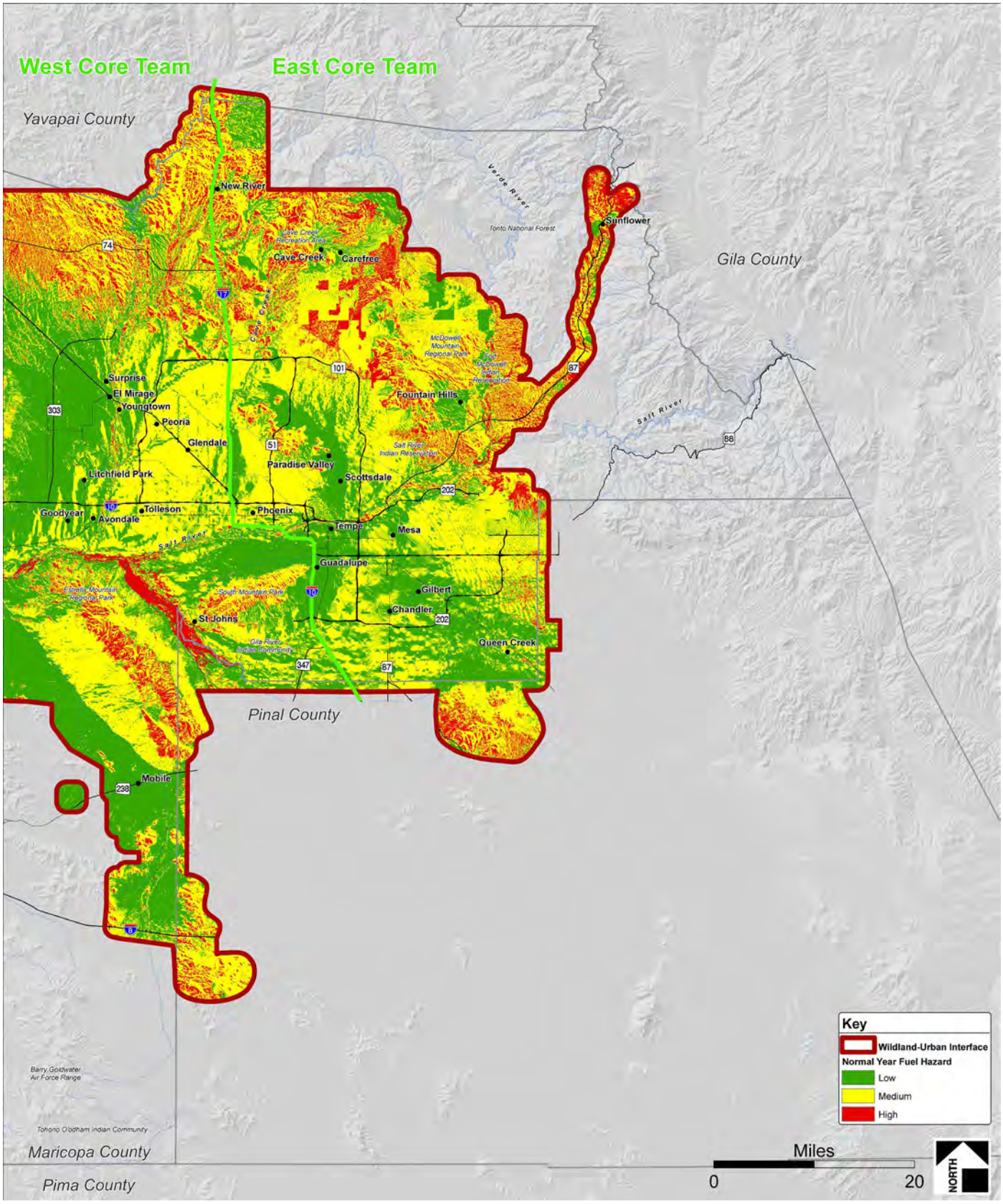

Figure 2.4a. Maricopa County CWPP wildland fuel hazards during typical fire season, east

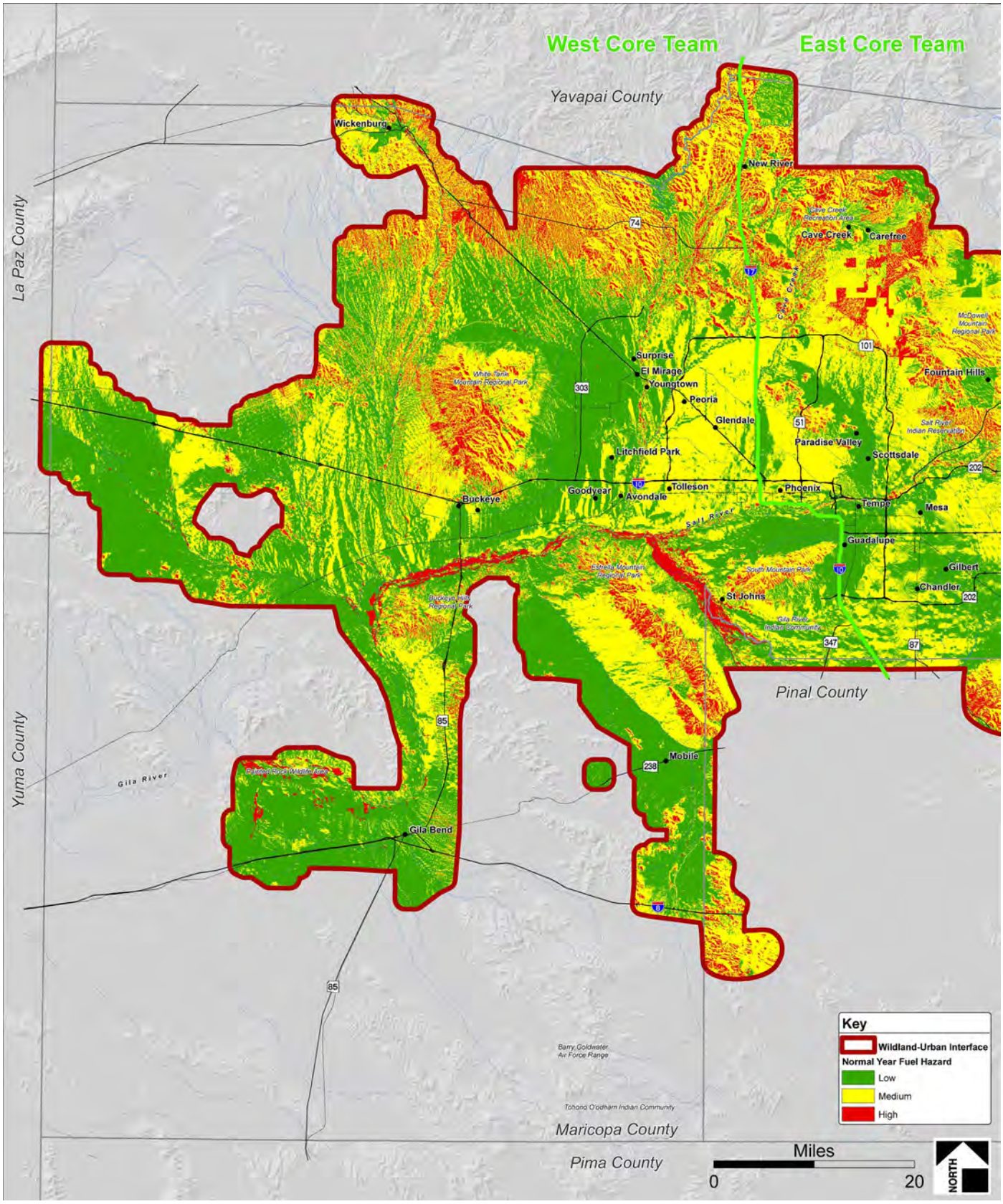

Figure 2.4b. Maricopa County CWPP wildland fuel hazards during typical fire season, west

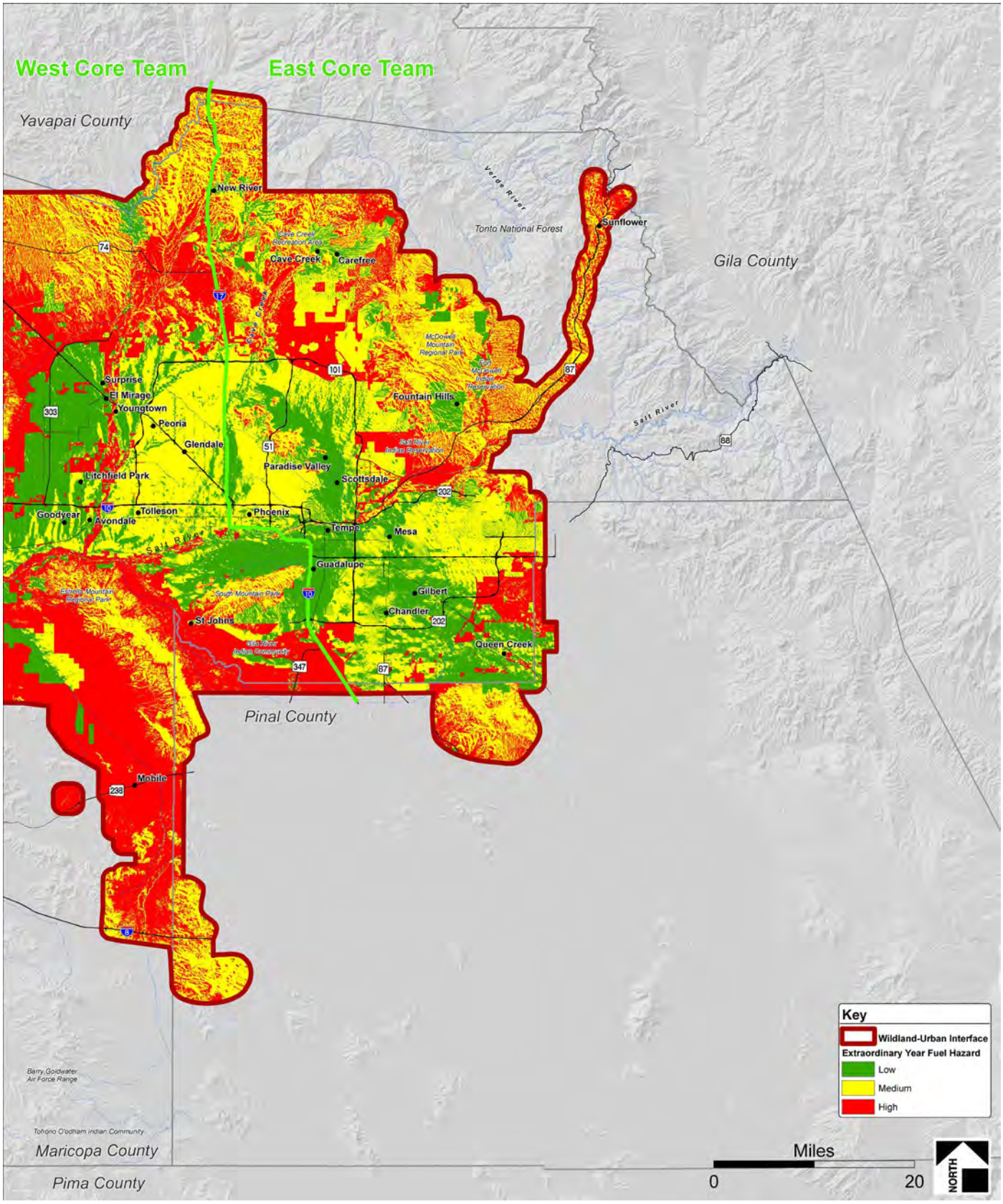

Figure2.5a. Maricopa County CWPP wildland fuel hazards during extraordinary rainfall years, east

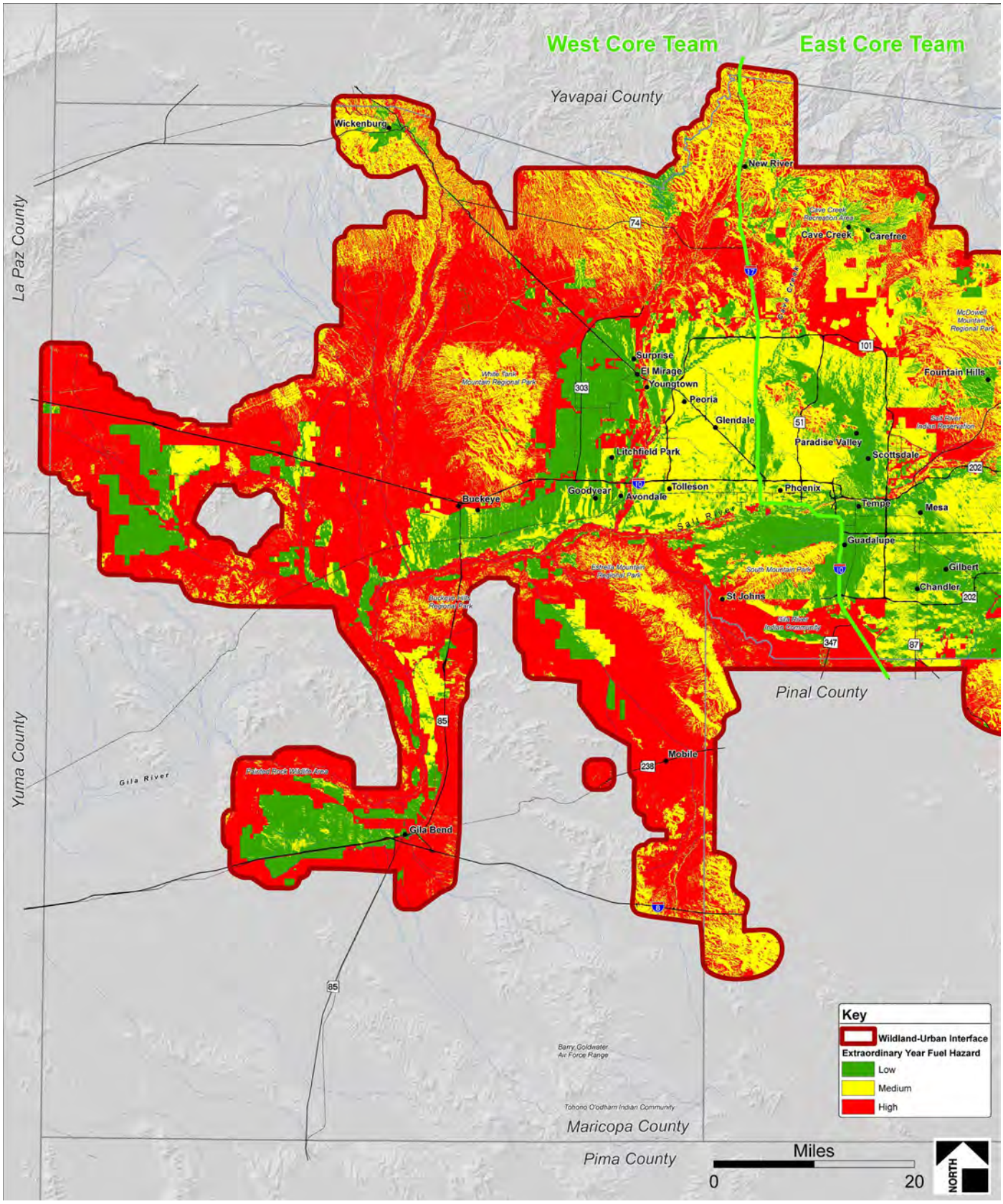

Figure2.5b. Maricopa County CWPP wildland fuel hazards during extraordinary rainfall years, west

Riparian corridors, shrublands, and vegetation associations occurring in steep slopes with a south or southwest aspect are the greatest wildland fuel hazards within the Maricopa 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 invaded 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/) and from the Arizona State Forester's Office. 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 and state agencies that have been merged into one fire history point layer. According to these data, 4,016 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 Gila River corridor, along the northeastern portion of the WUI, including Sunflower and New River areas, and also within the riparian corridors in the central portion of the WUI. Moderate fire occurrences are found associated in proximity to higher ignition areas and along the northern portion of the San Tan Mountain Regional Park east to the Interstate 10 (I-10) corridor (Figures 2.6a and 2.6b).

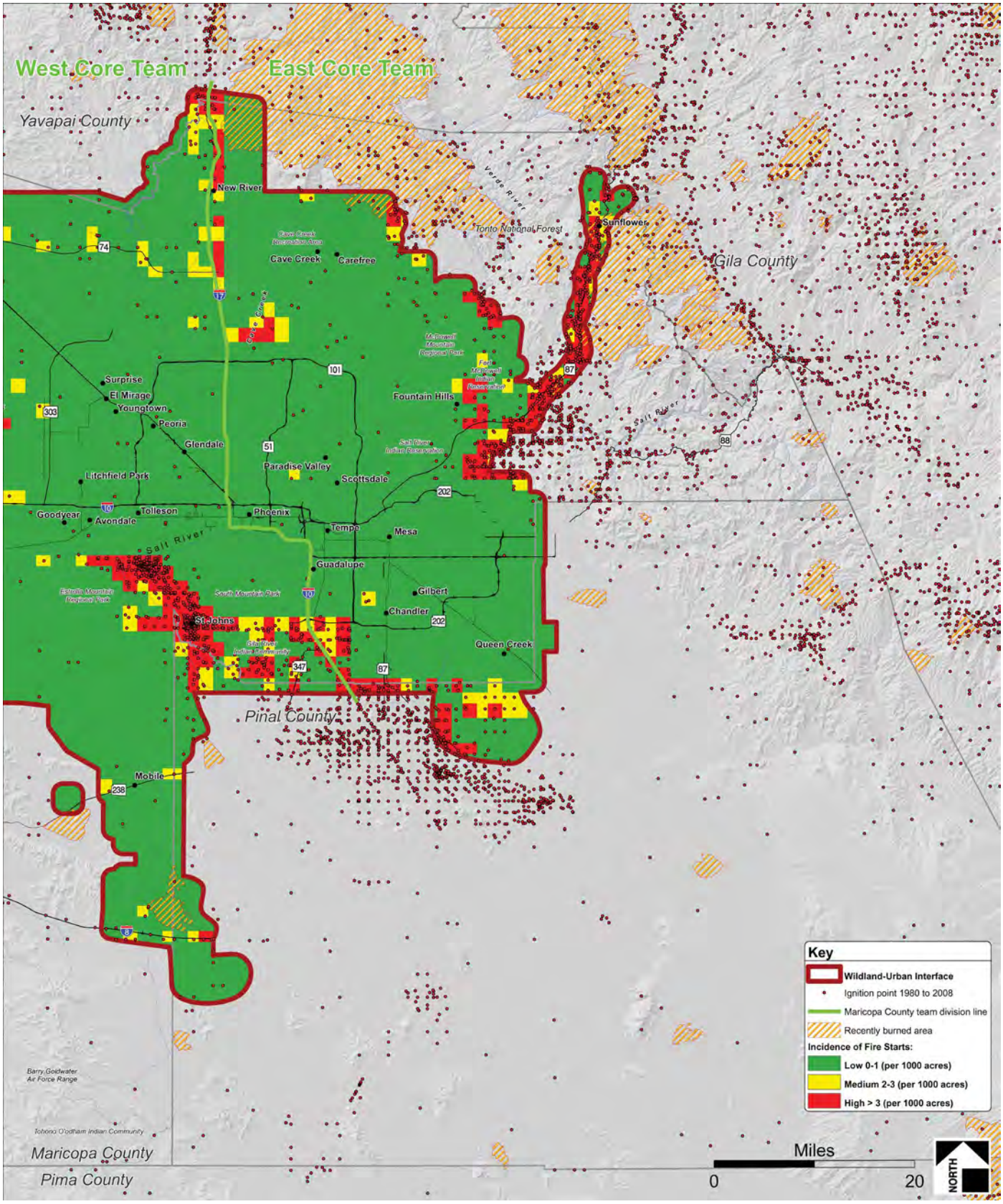

Figure 2.6a. WUI ignition history, east

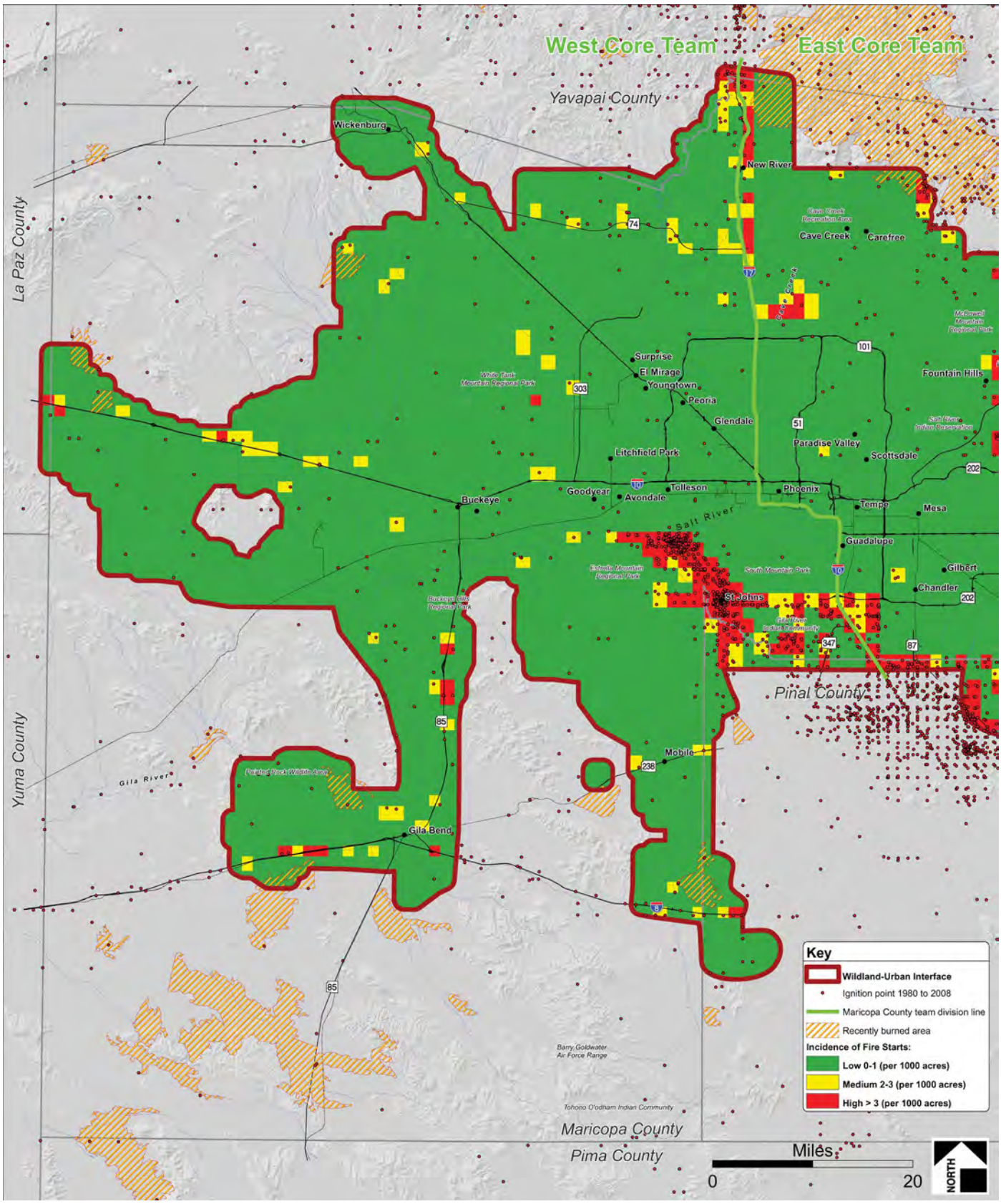

Figure 2.6b. WUI ignition history, west

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 Maricopa County WUI does include areas consistent with Risk Factor 2, Situations 1, 2, and 3, 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.

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

The Core Teams identified high-risk areas—including the major community cores and portions of I-10, Interstate 8 (I-8), Interstate 17 (I-17), US 60, SR 74, SR 85, SR 87, SR 88,—as the focus of commercial development. Residential community development is occurring throughout the WUI in a mix of high-density, single-family, and multiacre parcels. The Core Teams reviewed parcel data developed by Maricopa County to determine the distribution of private lands and lands uses within the WUI. These data were then portioned into risk categories depended on the level of development and presence of natural landcover types. This includes areas of highly developed lands that lack significant open space or natural land covers; moderately developed private lands where an intermingling of public and private lands occur and the major portion of the landscape are comprised as natural landcover types; and lightly developed private lands where the majority of land cover is composed of natural land cover. Areas of highest development were considered at low risk of wildfire, areas of moderate development are considered at high risk of wildfire, and areas of light development are considered areas at moderate risk of wildfire. Therefore, structures associated with housing and commercial development located in isolated subdivisions and in more dispersed areas of the WUI with higher Insurance Services Office (ISO) ratings are at highest 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 within and adjacent to the WUI—including camping and recreation areas associated with several regional parks; designated camping and recreation areas in the TNF and on BLM-managed public lands; wildlife areas; and major Forest Service trailheads—are located throughout Maricopa 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 Pronghorn (*Antilocapra Americana sonoriensis*), lesser long-nosed bat (*Leptonycteris curasoae yerbabuenae*), and Mexican spotted owl (*Strix occidentalis lucida*), while riparian corridors include southwestern willow flycatcher (*Empidonax traillii extimus*), bald eagle (*Haliaeetus leucocephalus*), California least tern (*Sterna antillarum browni*), Yuma clapper rail (*Rallus longirostris yumanensis*) and yellow-billed cuckoo (*Coccyzus americanus*) habitat. Aquatic habitats within Maricopa County support several species of fish, reptiles, and amphibians. The land-management agencies use accepted 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 due to the extraordinary circumstances created by the presence of sensitive species or their habitats. Before any vegetation treatment by the BLM, or TNF, 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 that would lessen 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 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 Maricopa 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 1 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, ASFD, and local fire departments and districts provide support for initial wildland fire attack for areas within and adjacent to the Maricopa County CWPP WUI. Initial-attack response from additional local fire departments and districts can occur under the authority of automatic aid system and 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 and TNF 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 14 percent (445,061 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 Maricopa County CWPP area consists of portions of BLM lands located throughout the WUI and TNF lands located in the northern and eastern portion of the WUI. Maricopa 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 Figures 2.7a and 2.7b.

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

E. Summary of Community Assessment and Cumulative Risk Analysis

The elected and appointed officials of Maricopa County and 26 participating jurisdictions within Maricopa County, demonstrated their commitment to hazard mitigation in 2003-2004 by preparing the first Maricopa County Multi-Jurisdictional Hazard Mitigation Plan (2004 Plan). The 2004 Plan was comprised of a multi-jurisdictional, county-wide umbrella plan and 27 jurisdiction specific annexes that addressed specific planning elements for each jurisdiction. The 2004 Plan was approved by FEMA on November 29, 2004 and requires a full, FEMA approved, update prior to the November 29, 2009 expiration (MCDEM 2009).

Maricopa County and local jurisdictions recognize the consequences of disasters and the need to reduce the impacts of natural and human-caused hazards. The County and jurisdictions also know that with careful selection, mitigation actions in the form of projects and programs can become long-term, cost effective means for reducing the impact of natural and human-caused hazards. In response, MCDEM secured a federal planning grant and hired JE Fuller/ Hydrology & Geomorphology, Inc. to assist the County and participating jurisdictions with the update process. MCDEM reconvened a multi-jurisdictional planning team (MJPT) comprised of veteran and first-time representatives from each participating jurisdiction, various county departments and organizations, Arizona Division of Emergency Management, National Weather Service, Arizona Geologic Survey, and APS. The MJPT met monthly through July 2009 in a collaborative effort to review, evaluate, and update the 2004 Plan into a single, consolidated Maricopa County Multi-Jurisdictional Hazard Mitigation Plan (Plan). The Plan also contains a Tribal Annex for each of the two participating Indian Tribes that address Tribal specific planning elements. The Plan will continue to guide the County and participating jurisdictions toward greater disaster resistance in full harmony with the character and needs of the community and region (MCDEM 2009).

The Plan has been prepared in compliance with Section 322 of the Robert T. Stafford Disaster Relief and Emergency Assistance Act (Stafford Act or the Act), 42 U.S. C. 5165, enacted under Sec. 104 the Disaster Mitigation Act of 2000, (DMA 2000) Public Law 106-390 of October 30, 2000, as implemented at CFR 201.6 and 201.7 dated October, 2007. The Plan identifies hazard mitigation measures intended to eliminate or reduce the effects of future disasters throughout the County, and was developed in a joint and cooperative venture by members of the Maricopa County MJPT (MCDEM 2009). The Maricopa County CWPP was developed to be complimentary to the Plan by developing a quantitative analysis of wildland fire risk across Maricopa County, designing mitigation measures and priority needs to implement mitigation measures, whether wildland fire fuel manipulations, resource response, reduced structural ignitibility or public education and outreach.

The major concerns identified by the Core Teams and collaborators are during the development of the MCCWPP include (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. 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 portions of the WUI where this service has not been instituted.

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 2008 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.

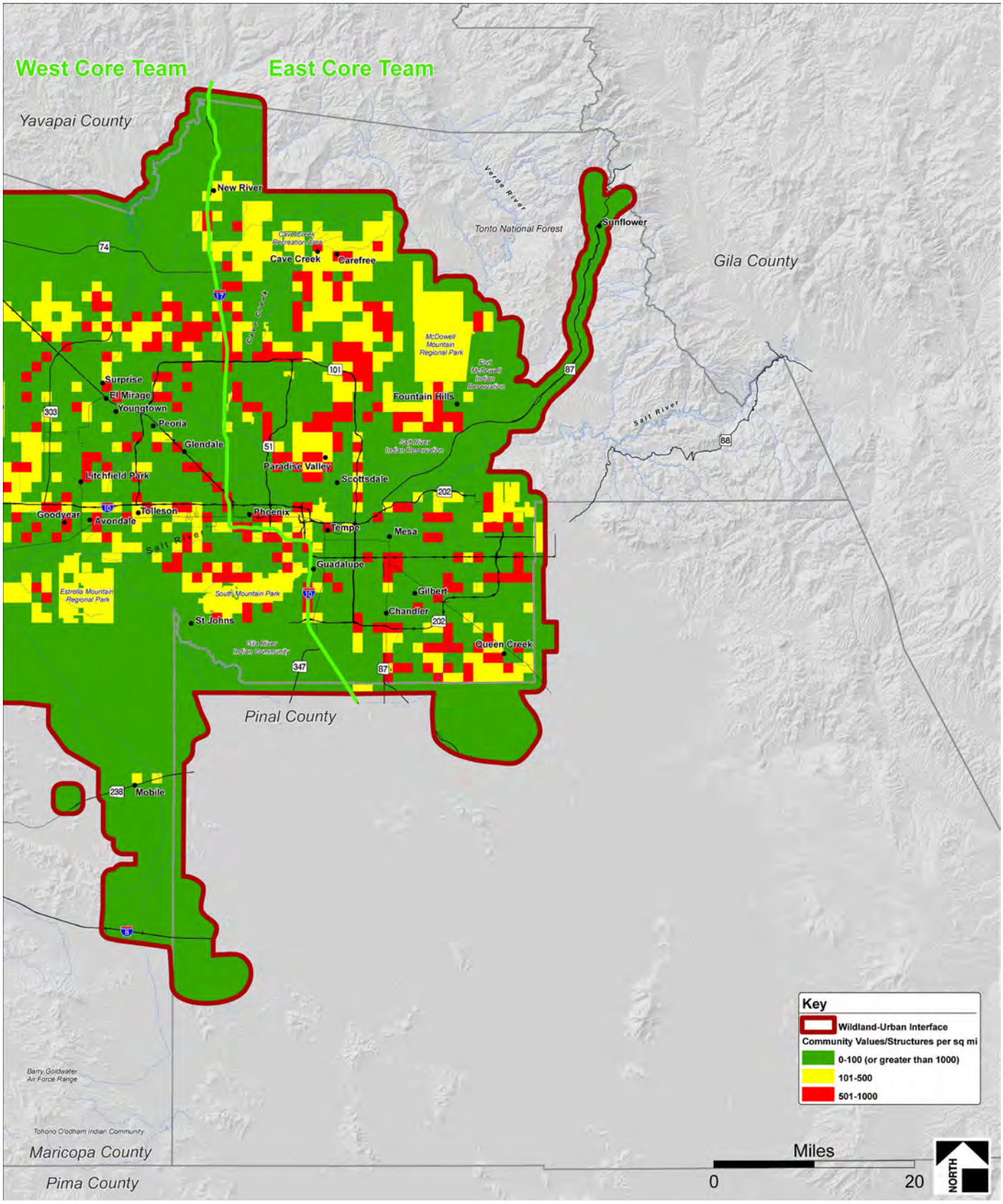

Figure 2.7a. Maricopa County CWPP community values, east

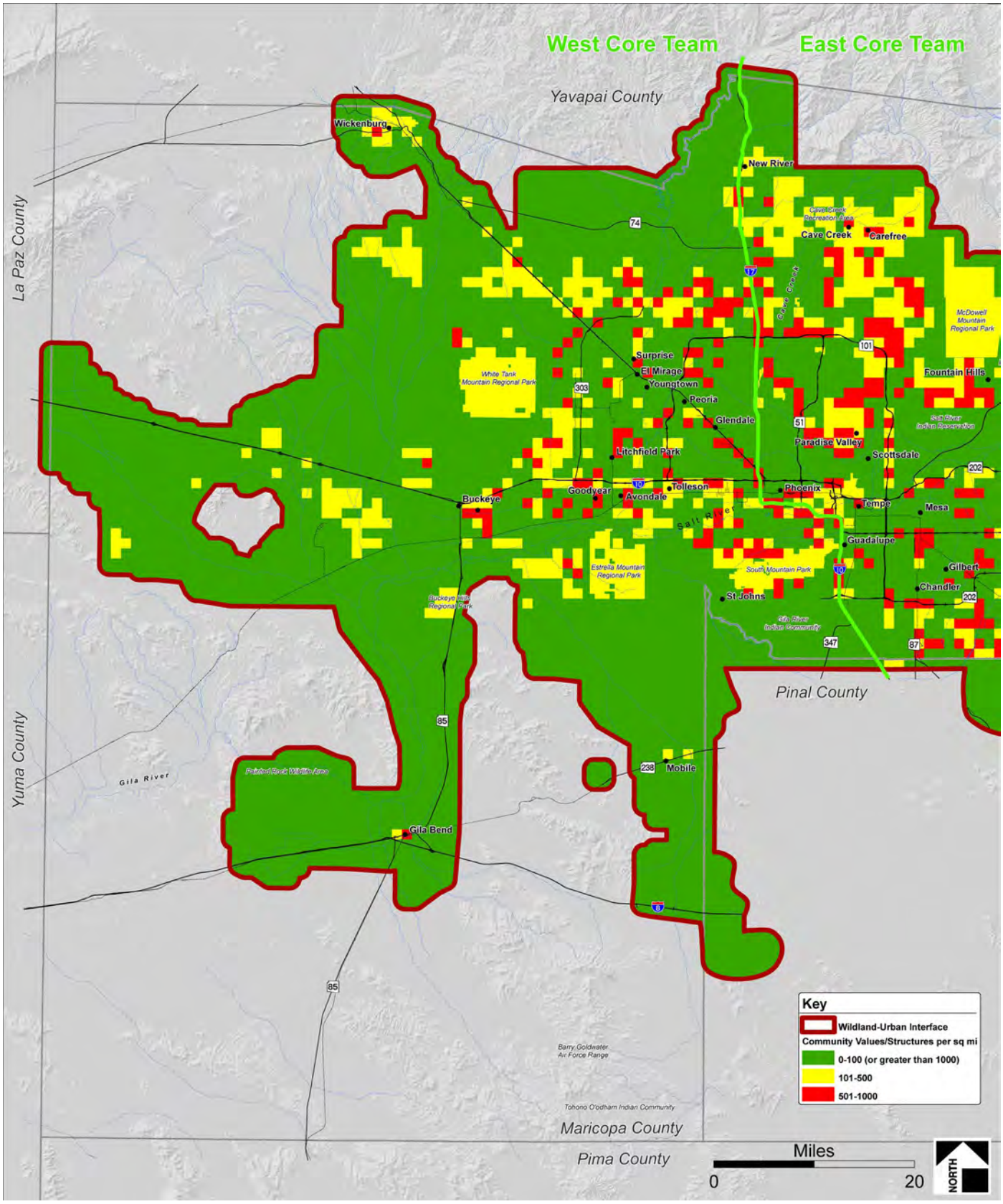

Figure 2.7b. Maricopa County CWPP community values, west

In addition, largely unincorporated areas of the WUI that are not under the jurisdiction of a fire department or fire district and that may or may not be serviced by individual subscriptions to Rural/Metro Fire Department are described as "management areas." These management areas are included with the nearest community sub–WUI descriptions and potential wildland fire risk rating.

1. Eastern Sub-WUI Communities

Sunflower Sub-WUI

The Sunflower sub-WUI includes the rural areas surrounding the community of Sunflower, including Sycamore Creek and Diamond Mountain. "Sunflower was a cavalry water station in 1868 and was a side station to Camp Reno. Known as Camp O'Connell, there was one building by the roadside on a military road from Fort McDowell to Camp Reno and to Payson. The military camp left Sunflower in April 1870. Sunflower was a short-lived PO in Maricopa County (1943–1949); the area was known locally as Diamond Ranch (T6N R9E). The Sunflower area is also home to the Sunflower Mine otherwise known as the National Mine . . . The Sunflower mine produced mercury . . . The mine works building still stands and the processing machinery can still be seen" (http://www.ghosttowns.com/states/az/sunflower.html). Transportation routes into Sunflower include SR 87 (Beeline Highway) and Sycamore Creek Road. The community of Sunflower is included within the *Arizona-Identified Communities at Risk* (Arizona State Forester 2009) to be at a low risk of wildland fire. The Sunflower sub-WUI is primarily composed of palo-verde mixed cacti vegetative communities at lower elevations, with chaparral and other woodland and riparian associations dominating higher elevations. These vegetative fuel types are conducive to intensive wildland fire due to contiguous aerial and ground fuels. Additionally, this sub-WUI has a history of high numbers of wildland fire ignitions. There are no major communities within this portion of the sub-WUI, and the number of private land parcels is reported as low. The area at highest wildfire risk within the WUI occurs along the SR 87 corridor immediately south of the private lands; this area's high vegetative fuel risk is associated with recurring slope and high ignition history. Sunflower has an ISO rating of 10 and there is no fire district within the WUI. Private lands within the Sunflower area are adjacent to TNF lands. TNF responds to wildland fire within this sub-WUI. Due to a primarily high wildfire risk, a high ignition history, a low to moderate density of community values, and no responding fire department or district, the overall wildland fire risk rating of the sub-WUI is high.

Carefree Sub-WUI

The Carefree sub-WUI includes the community of Carefree and surrounding natural areas. Carefree is a residential community with a heavy emphasis on resort-style living. Tourism composes a large portion of the area's economy. A substantial number of retail and commercial establishments serve the community's residents. The primary transportation corridor into Carefree is Cave Creek Road. The population of Carefree, according to the Arizona Department of Economic Security and the US Census Bureau (2008), is 3,948 people, which is up from 2,927 in 2000. In 2000 there were 1,834 housing units (1,397 occupied: 1,227 owner occupied; 170 renter occupied) in Carefree, which is a density of 207 houses/condos per square mile. Carefree's fire protection is provided through a master contract with Rural/Metro Fire Department. Rural/Metro Fire Department is a private fire protection company that serves incorporated

communities through master contracts or subscriptions with individual homeowners. Carefree has codified its fire department and owns the fire stations and associated equipment within the incorporated community. Rural/Metro provides firefighters, management oversight, and support services to the town. The Carefree Fire Department has responded to 38 wildland fires from 2001 through 2009 within this WUI. Carefree does recognize potential wildfire issues with slope and vegetation and with some washes that have heavy vegetative growth. Carefree prefers to maintain a program of public information and firefighter education. The public education program has been an ongoing project delivered primarily through mailings in residents' monthly water bills in the spring and through the local newspaper. The program has been very successful, and defensible space around private residences is the norm rather than the exception. Firefighter training is delivered by Rural/Metro Fire Department to Carefree Fire Department's employees. Rural/Metro has a long history of responding to wildland fires with crews highly trained in wildland fire suppression. Carefree is also a member of the Arizona Mutual Aid Compact and has an IGA with ASLD. The Carefree Fire Department has an ISO rating of 3/9. The Carefree sub-WUI is composed primarily of paloverde-mixed cacti vegetation associations and developed, open space–low intensity lands. The area at highest risk for wildland fires within the WUI occurs within areas of increased slope to the north of the community (Continental Mountain area) and to the Seven Springs area northeast of the community. This portion of the sub-WUI also includes areas of low wildfire ignitions. Due to a primarily moderate 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 moderate.

Cave Creek Sub-WUI

The Cave Creek sub-WUI includes the community of Cave Creek and the surrounding natural areas, including Cave Creek Wash and the Cave Creek recreation area. Cave Creek is a residential community with a heavy emphasis on resort-style living. Tourism composes a large portion of the area's economy. A substantial number of retail and commercial establishments serve the community's residents. The primary transportation corridor into Cave Creek is Cave Creek Road. The population of Cave Creek, according to the Arizona Department of Economic Security and the US Census Bureau (2008), is 5,132 people, which is up from 3,728 in 2000. As of the 2000 census, there were 1,753 housing units, which is an average density of 62.1 houses/condos per square mile. Fire protection for Cave Creek is provided through subscriptions to Rural/Metro Fire Department. During 2001 through 2009 the Cave Creek Fire Department responded to 89 wildland fires within and adjacent to the community. The communality of Cave Creek does recognize potential wildland fire issues with slope and with high-risk vegetation associations, including invasive species. Cave Creek prefers to maintain programs aimed at public education and outreach and firefighter training. Cave Creek has a work group that has been pursuing grants for invasive-species abatement but has yet to obtain such a grant. Cave Creek will continue to pursue grant opportunities. The Town of Cave Creek does have an IGA with ASLD for wildland fire response and is a member of the Arizona State Mutual Aid Compact. Rural/Metro Fire Department responds to wildland fires for this WUI. Rural/Metro Fire Department has an ISO rating of 5/9 for the Cave Creek area. The areas of highest wildfire risk are located along Cave Creek Wash and the foothills north and west of town. Major vegetation associations include the paloverde-mixed cacti desert scrub within the community, with mesquite upland and chaparral associations occurring in higher elevations to the north of the community. This portion of the sub-WUI does include

areas of moderate vegetation risk during extraordinary rainfall years. Wildfire ignitions within the Cave Creek sub-WUI are low; however, the Cave Creek recreation area is considered a moderate risk to high human use in undeveloped areas of the sub-WUI. Due to a low/moderate 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 moderate.

New River Sub-WUI

The New River sub-WUI includes the community of New River and the surrounding natural area, including New River Wash for which the community was named. New River has largely retained its rural character; however, its future as a rural community is uncertain as the city of Phoenix expands into the region. As of the 2000 census, the population of New River was 10,781, and there were 4,494 housing units (3,929 occupied: 3,621 owner occupied; 308 renter occupied), which is a housing density of 63 houses/condos per square mile. Transportation routes into New River are I-17, Lake Pleasant Road, and New River Road. New River is serviced by the Daisy Mountain Fire District; this fire district also responds to wildland fire threats within the WUI. The community of New River is included within the *Arizona-Identified Communities at Risk* (Arizona State Forester 2009) to be at a moderate risk of wildland fire. Areas of highest wildfire risk are located along the I-10 corridor both south and north of the community. The primary vegetation association within the sub-WUI is paloverde-mixed cacti. During extraordinary rainfall years this portion of the sub-WUI lies within the slopes of the foothills of the New River Mountains. The paloverde-mixed cacti association occurring in slopes of excess of 20 percent with a southerly exposure can produce high wildland risk conditions. This portion of the sub-WUI does include areas of high risk based on wildfire ignitions within the I-10 corridor. Due to areas of high vegetation wildfire risk, areas of high ignition history, and a low to moderate density of community values, the overall wildland fire risk rating of the sub-WUI is high.

Fountain Hills and Management Area 11 Sub-WUI

The Fountain Hills sub-WUI includes the town of Fountain Hills and natural areas such as the McDowell Mountain Regional Park (Management Area 11) and the Verde River corridor. The population of Fountain Hills, according to the Arizona Department of Economic Security and the US Census Bureau (2008), is 25,995 people, which is up from 20,235 in 2000. In 2000 there were 10,498 housing units (8,647 occupied: 7,237 owner occupied; 1,410 renter occupied) in Fountain Hills, which is a housing density of 578 houses/condos per square mile. Fountain Hills offers a broad range of community facilities, including a community center, library, several parks, children's playground, tennis and basketball courts, baseball fields, and a 25-acre park. Transportation routes into the area are SR 87 (Beeline Highway), Shea Boulevard, and Rio Verde Drive. Fire protection to the town of Fountain Hills is provided through a master contract with Rural/Metro Fire Department. The Town of Fountain Hills has codified its fire department. The Fountain Hills Fire Department includes two Type 1, one Type 2, and one Type 7 fire engines. Rural/Metro Fire department provides 28 firefighters trained in wildfire suppression. The Fountain Hills Fire Department responds to wildland fire threats within the WUI and maintains an ISO rating of 3. The highest wildfire risk occurs in the community core and in areas with slope and southerly aspect effects on paloverde-mixed cacti vegetative associations during extraordinary rainfall years. This portion of the sub-WUI does include

areas of moderate risk based on wildfire ignitions in proximity to the Verde River riparian corridor. Due to areas of high to moderate wildfire risk, a moderate ignition history, and a high to moderate density of community values, the overall wildland fire risk rating of the sub-WUI is moderate.

Paradise Valley Sub-WUI

The Paradise Valley sub-WUI includes the town of Paradise Valley and the surrounding natural areas such as the Phoenix Mountain Preserve. Paradise Valley is generally an upscale residential community known for its excellent school system. The population of Paradise Valley, according to the Arizona Department of Economic Security and the US Census Bureau (2008), is 14,444 people, which is up from 13,664 in 2000. Transportation routes into the area are Shea Boulevard and Pima Road. In 2000 there were 5,499 housing units (5,034 occupied: 4,885 owner occupied; 149 renter occupied) within Paradise Valley. The Town of Paradise Valley contracts with the City of Phoenix to provide community fire services. The highest wildfire risk occurs in the community core and in the Phoenix Mountain Preserve and Camelback Mountain areas where slope and southerly aspect effects on paloverde-mixed cacti vegetative associations occur during extraordinary rainfall years. This portion of the sub-WUI does include areas of low risk based on wildfire ignitions. Due to areas of high to moderate wildfire risk, a low ignition history, and a high to moderate density of community values, the overall wildland fire risk rating of the sub-WUI is moderate.

Scottsdale Sub-WUI

The Scottsdale sub-WUI includes the city of Scottsdale and the surrounding open space. The city boundary officially covers 184 square miles, and the community offers a wide range of cultural, recreational, and natural environmental features, including the McDowell Sonoran Preserve. When completed, the preserve will cover approximately 36,400 acres—57 square miles (or one-third of the community)—a unique 7.5-mile greenbelt offering an endless range of local recreational opportunities; and the Westworld event complex that hosts a wide range of major equestrian and visitor activities, including signature events like the Barrett-Jackson Classic Car Auction. Scottsdale is physically bordered by Phoenix and Paradise Valley to the west, Carefree and the TNF to the north, and unincorporated areas and the Salt River Pima-Maricopa Indian Community to the east.

The population of Scottsdale, according to the Arizona Department of Economic Security and the US Census Bureau (2008), is 242,337 people, which is up from 202,705 in 2000. In 2000 there were 104,949 housing units (90,643 occupied: 63,089 owner occupied; 27,545 renter occupied) within Scottsdale, which is a housing density of 570 houses/condos per square mile. The primary transportation routes for the community are the east and north segments of the Loop 101 freeway, along with the following major surface streets: Bell Road/Frank Lloyd Wright (east-west), Shea Boulevard (east-west), Dynamite/Rio Verde Drive (east-west), Scottsdale Road (north-south), Hayden Road (north-south), and Pima Road (north-south).

The Scottsdale Fire Department, with an ISO community rating of 3, is responsible for responding to wildland fire threats within the local WUI. These areas are primarily located along the Shea Boulevard corridor and north and east of the Loop 101 freeway and the CAP Canal. Approximately 128 of the city's 184 square miles are located in this area, which also includes the McDowell Sonoran Preserve, along with

the southwest slopes and alluvial-fan areas of the McDowell Mountains. The commercial and residential developments in this area are covered by an ESLO (Environmentally Sensitive Land Ordinance) and by NAOS (Natural Area Open Space) overlay requirements. The core segments of the community in this area have the highest risk of wildfire in the WUI. These high Sonoran Desert locations have many lush areas covered with paloverde-mixed cacti vegetative models, which can increase the fuel loads dramatically during extraordinary rainfall years. Because of the identified risk and large WUI area, the Scottsdale Fire Department has aggressively obtained resources and worked with various community groups to address the wildfire threat. The City has a response agreement with TNF for a 1-mile-in/1-mile-out area along their shared borders. Scottsdale also has two 2,500-gallon water tenders; four Type 6 brush trucks; one four-wheel-drive gator outfitted with a brush pack; and one wildland cache/support truck with additional hand tools, hoses, and adaptors. The Scottsdale Fire Department regularly conducts wildland fire training for its full-time firefighters, and all of the city's engine companies are outfitted for initial WUI fire attack. Meetings with individual homeowners and the numerous associations that are adjacent to the open preserve areas have resulted in a tremendous amount of fuel management activities and defensible space being established. Community handouts that identify how to establish proper defensible space in these sensitive areas have been developed and distributed. In addition, an invasive-plant brochure was developed with assistance from the McDowell Sonoran Preserve Commission; this educational brochure has received a very positive response from the residents in the WUI areas of the community. The extensive community outreach effort in these WUI areas has resulted in Ancala West receiving the first official Firewise Community certification in Maricopa County. The Scottsdale Fire Department expects that several other local homeowner organizations and master-planned communities will be able to meet the guidelines and become Firewise certified in the near future.

This portion of the sub-WUI does include areas of low risk based on wildfire ignition in proximity to the McDowell Mountains. Due to areas of high to moderate wildfire risk, a low ignition history, and a high to moderate density of community values, the overall wildland fire risk is moderate.

Phoenix Sub-WUI

The Phoenix sub-WUI includes the city of Phoenix, surrounding communities, and natural areas such as Papago Park and South Mountain Park. Phoenix is the seventh largest city in the nation. The hub of the rapidly growing Southwest, it is Arizona's capital and the Maricopa County seat. The population of Phoenix, according to the Arizona Department of Economic Security and the US Census Bureau (2008), is 1,561,485 people, which is up from 1,321,045 in 2000. In 2008 there were 554,468 housing units (484,796 occupied: 297,041 owner occupied; 187,755 renter occupied). Transportation routes into the area are I-17, I-10, US 60, and the Burlington Northern Santa Fe and Union Pacific railroads. The Phoenix Fire Department responds to wildland fire threats within the WUI. The highest wildfire risk occurs in the community core and in the areas of Squaw Peak, North Mountain, Shaw Butte, and Lookout Mountain where slope and southerly aspect effects on paloverde-mixed cacti vegetative associations occur during extraordinary rainfall years. This portion of the sub-WUI does include areas of low risk based on wildfire ignitions in proximity to these areas of higher slope. Due to areas of high to moderate 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.

Mesa Sub-WUI

The Mesa sub-WUI includes the city of Mesa and surrounding communities and natural areas. Mesa offers a quality urban experience supported by a diversified economic base in proximity to a variety of outdoor recreational opportunities—including plentiful hiking trails at Usery Mountain Recreation Area in northeast Mesa and Lost Dutchman State Park near the Superstition Mountains; tubing on the Salt River; and the Apache Trail, a scenic drive that includes Goldfield Ghost Town, Canyon Lake, and Tortilla Flat Saloon and Restaurant. The population of Mesa, according to the Arizona Department of Economic Security and the US Census Bureau (2008), is 459,682 people, which is up from 396,375 in 2000. There are 193,952 housing units (169,028 occupied: 112,988 owner occupied; 56,040 renter occupied) in Mesa. This sub-WUI also includes the unincorporated areas of Maricopa County east of the city of Mesa. Fire protection for this area is serviced by the Rural/Metro Fire Department on an individual subscription basis or through master agreements with specific homeowner associations. This area is bounded by the Pinal County line on the south, SR 79 seven miles to the east, Power Road on the west, and the TNF on the north. The ISO rating for this area is 4/9. The Rural/Metro Fire Department maintains 70 personnel all trained in wildland fire suppression, including five type 1 fire engines, one Type 2 tender, two Type 6 fire engines, and one Type 3 fire engine. The Mesa Fire Department responds to wildland fire threats within the WUI. Mesa has an ISO rating of 3. Resources include 388 sworn fire personnel, 20 Type 1 pumpers, 5 Type I ladder trucks, 1 Type 2 water tender, and 4 Type 6 fire brush trucks. The highest wildfire risk is associated with paloverde-mixed cacti vegetation in the southeastern area of the city and in open space areas between the community of Queen Creek and the city of Mesa during extraordinary rainfall years. This portion of the sub-WUI does include areas of low risk based on wildfire ignitions in proximity to these open spaces. Due to areas of primarily low to moderate wildfire risk, a low ignition history, and primarily low to moderate density of community values, the overall wildland fire risk rating of the sub-WUI is low.

Tempe Sub-WUI

The Tempe sub-WUI includes the city of Tempe and surrounding communities. Tempe is an urban community located in the center of the Phoenix metropolitan region and is home to Arizona State University, Tempe Town Lake, and Tempe Beach Park. The population of Tempe, according to the Arizona Department of Economic Security and the US Census Bureau (2008), is 162,468 people, which is up from 158,625 in 2000. There are 66,145 housing units (58,741 occupied: 29,101 owner occupied; 29,640 renter occupied) in Tempe. Transportation routes into the area are US 60, Loop 101, Loop 202, and the Union Pacific Railroad. The Tempe Fire Department, with an ISO rating of 2, responds to wildland fire threats within the WUI. Areas of highest wildfire risk are located adjacent to the Salt River corridor as it passes through the community. This portion of the sub-WUI does include areas of low risk based on wildfire ignitions in proximity to the Salt River. Due to areas of 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.

Guadalupe Sub-WUI

The Guadalupe sub-WUI includes the community of Guadalupe, a Yaqui Indian and Mexican community between Phoenix and Tempe at the base of South Mountain. The population of Guadalupe, according to the Arizona Department of Economic Security and the US Census Bureau (2008), is 5,990 people, which is

up from 5,228 in 2000. In 2000 there were 1,184 housing units (1,110 occupied: 761 owner occupied; 349 renter occupied) in Guadalupe, with a housing density of 1,543 houses/condos per square mile. I-10 is the major transportation route into the area. The risk of wildland fire is minimal within the community of Guadalupe. Due to areas of 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.

Gilbert Sub-WUI

The Gilbert sub-WUI includes the city of Gilbert and Gilbert County Island Fire District area. The population of Gilbert, according to the Arizona Department of Economic Security and the US Census Bureau (2008), is 214,820 people, which is up from 109,697 in 2000. There are 66,398 housing units (61,630 occupied: 48,251 owner occupied; 13,379 renter occupied) in Gilbert. The Gilbert Fire Department, with an ISO rating of 4/9, responds to wildland fire threats within the WUI. There is less than 200 acres of high wildland fire risk areas within the Gilbert sub-WUI. Vegetation associations are primarily creosotebush types, which have a low potential to support or transport wildfire and a low history of wildland fire ignitions. Due to areas of 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.

Chandler Sub-WUI

The Chandler sub-WUI includes the city of Chandler and the surrounding communities. The population of Chandler, according to the Arizona Department of Economic Security and the US Census Bureau (2008), is 244,376 people, which is up from 176,581 in 2000. There are 96,434 housing units (87,265 occupied: 59,723 owner occupied; 27,542 renter occupied) in Chandler. Transportation routes into the area are Loop 101, US 60, and the Union Pacific Railroad. The Chandler Fire Department, with an ISO rating of 3, responds to wildland fire threats within the WUI. The Chandler Fire Department maintains wildland fire response and suppression capabilities including one Type 1 and one Type 6 fire engine. The Chandler Fire Department has a formal agreement with ASLD to provide labor and resources when needed for wildland fire suppression within the state. There is less than 600 acres of high wildland fire risk areas within the Chandler sub-WUI. Vegetation associations are primarily creosotebush types, with low potential to support or transport wildfire and a low history of wildland fire ignitions. Due to areas of 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.

Rio Verde/Tonto Hills and Unincorporated Sub-WUI

Within the northern area of the eastern WUI communities, Rural/Metro serves the unincorporated areas of the Rio Verde corridor (bounded by TNF to the north, 136 Street to the west, 171 Street to the east, and Pinnacle Vista to the south) and the unincorporated areas between Scottsdale, Phoenix, Carefree, and Cave Creek (Dynamite Road on the south, Scottsdale Road on the east, 40th Street on the west, and Carefree Highway on the north). These areas have an ISO rating of 9. These unincorporated areas are serviced by two Type 1 engines, one Type 6 engine, and one Type 2 tender. There are 31 firefighters trained for wildland fire response and suppression. All of these areas have mutual-aid agreements with Scottsdale, Phoenix, and the Rio Verde Fire District for assistance when needed in their respective

communities. Additionally, Tonto Hills has a volunteer fire department. Some of these are formal agreements through an individual town, and some are through agreements with Rural/Metro. The Rural/Metro Fire Department maintains a wildfire response group. This group is composed of an overhead team (ratings at engine boss and above). Seven personnel are assigned to the group and are on call year-round for wildland fire response. The Rural/Metro Fire Department also employs 10 seasonal wildland firefighters during the active fire season and maintains 12 reserve firefighters on call year-round. All firefighters in this group are trained in wildland fire suppressions ("red carded"). This group is supported by Type 6 fire engines, water tenders, and Type 3 fire engines from the Maricopa County operations and also has access to Pinal County units. The Rural/Metro Fire Department has an IGA with ASLD that includes all service areas, including those communities that have their own formal agreement. The Rural/Metro Fire Department has a 1-mile-in/1-mile-out agreement with TNF along their shared boundaries. The Rural/Metro Fire Department has its own dispatching system linked to both the Mesa and Phoenix Regional Dispatching systems for mutual-aid response. All units have the capability for integrated communication with other cooperating agencies, including ASF, TNF, and adjoining fire departments and districts. Areas of highest wildfire risk are located within the Verde River corridor and within areas of higher slope and chaparral vegetation communities along the northern and eastern WUI boundary. The Rio Verde Fire District has responded to 57 wildland fires from 2001 through 2009. This portion of the sub-WUI does include areas of high risk based on wildfire ignitions in proximity to these areas of higher slope. Due to areas of high to moderate wildfire risk, areas of high ignition history, and a low to moderate density of community values, the overall wildland fire risk rating of the sub-WUI is moderate.

Fort McDowell Yavapai Indian Nation Sub-WUI

The Fort McDowell Yavapai Indian Nation is centrally located within Maricopa County. Its topography ranges from tree-lined river bottoms to cactus-studded rolling desert. Created by executive order on September 15, 1903, the 24,680-acre reservation is home to the Yavapai people. The reservation is only a small parcel of land that was once considered ancestral territory of these nomadic bands of people who hunted and gathered food in central Arizona and the Mogollon Rim country. Fort McDowell was named after General Irwin McDowell. The reservation post was one of the most important outposts in the Southwest during the Apache Wars between 1865 and 1891. Fort McDowell's prime economic activity is its casino; built in 1984, it now occupies nearly 150,000 square feet and has 950 employees. Other businesses included a large sand and gravel quarry operation; a concrete plant; a 2,000-acre farm; a gas station; and western-adventures catering facility. Nearby is the Out of Africa Wildlife Park. The Arizona Department of Commerce and the US Census Bureau reported the population of the Fort McDowell Yavapai Indian Nation at 602 in 1990 and 743 in 2000. The Fort McDowell Yavapai Indian Nation sub-WUI is composed primarily of paloverde-mixed cacti and creosotebush-bursage vegetation associations that do not, under normal circumstances, support wildland fire. This portion of the sub-WUI includes areas of low risk based on wildfire ignitions. Due to limited areas of low wildfire risk, low ignition history, and areas of low density of community values, the overall wildland fire risk rating of the sub-WUI is low.

Queen Creek and Management Area 12 Sub-WUI

The Queen Creek sub-WUI includes the town of Queen Creek and the San Tan Mountains Regional Park (Management Area 12). The population of Queen Creek, according to the Arizona Department of Economic Security and the US Census Bureau (2008), is 23,827 people, which is up from 4,316 in 2000. There are 10,256 housing units (9,016 occupied: 7,623 owner occupied; 1,393 renter occupied) in Queen Creek. Transportation routes into the area are Power Road, Chandler Heights Road, and the Union Pacific Railroad. The Queen Creek Fire Department responds to wildland fire threats within the WUI; it maintains two Type 1 fire engines for structure protection, one Type 1 tactical water tender, and one Type 6 brush truck and has firefighters trained in wildland fire suppression. In addition, the Town of Queen Creak Fire Department has developed and published the *Town of Queen Creek Fire Department 2009 Wildland Fire Risk Assessment* (Assessment). This Assessment divides the town into four quadrants, delineates and describes areas of concern, and makes recommendations for enhanced firefighter and public safety enhancements; these recommendations are included in Section 3 of the Maricopa County CWPP. The Assessment concludes that the Town of Queen Creek does have a moderate to high chance for catastrophic fire within the town limits. The Town of Queen Creek does have an IGA with ASLD for wildland fire response and is a member of the Arizona State Mutual Aid Compact. The Queen Creek Fire Department has an ISO rating of 6/9. Areas of highest wildfire risk are located to the south of the community within the unincorporated areas north of the San Tan Mountains adjacent to the San Tan Mountain Regional Park. This portion of the sub-WUI does include areas of moderate risk based on wildfire ignitions in proximity to these areas of higher slope, which are highly infested with buffelgrass. Additionally, the riparian corridors of Queen Creek and Sonoqui Wash are highly infested with saltcedar. Due to areas of moderate to high wildfire risk, areas of moderate ignition history, and a moderate density of community values, the overall wildland fire risk rating of the sub-WUI is moderate.

Salt River Pima-Maricopa Indian Community Sub-WUI

The Salt River Pima-Maricopa Indian Community (SRPMIC) sub-WUI includes the communities under the jurisdiction of the SRPMIC. US census data were not readily available for this analysis. The SRPMIC is a compact tribe that manages its own wildland fire program with recommendations from the regional office. There are fire-control objectives identified by the Fire Management Office with respect to response times, control resources, control limits by acreage, and development of extended-attack mutual-aid agreements. Fire-control restraints within the community that have been identified include aerial support from at least one aircraft, a limited number of Type 4 through 6 engines, and limited access to portions of the community. During 2009 the SRPMIC Fire Department responded to 12 wildfire fires; all of these were kept to acceptable acreage limits with initial-attack resources. The SRPMIC Fire Department operates from four stations located throughout the community. There are three Type 1 and one Type 6 engines that are available for initial-attack response. In addition, there are two Type 1 engines that can be placed in service from reserve, one of which could be deployed outside the community. There are 25 trained personnel working per shift. Each firefighter is trained to National Wildland Coordinating Group (NWCG) standards and has been issued personal protective equipment (PPE) that includes one fire shelter per position. The fire department receives recurring preparedness funding from the BIA through the Office of Self-Governance. The last fiscal year funding was $28,400.00. These funds are received by the Office of Self-

Governance and set aside by the SRPMIC in a fund earmarked specifically for the wildland fire program. It is the fire department's basic policy to suppress all wildland fires within the community. There are standard operating guidelines (SOGs) that prescribe the proper and safe methods for activities on wildland fire incidents. The BIA has given the authority to the SRPMIC Fire Department to suppress all wildland fires within the community. There are some mutual-aid agreements that the SRPMIC has approved with neighboring jurisdictions to assist in initial-attack operations. An MOU has been developed between the BIA and the USDA Forest Service for those wildland areas where there are contiguous borders. The majority of the fire management philosophy comes from the *Wildland and Prescribed Fire Management Plan* (May 2000), which was developed for the Salt River Agency.

The SRPMIC consists of a 56,000-acre fire management zone (FMZ). The FMZ is broken into two initial-attack zones (IAZs) that identify the different attack strategies. One of the IAZs is a 19,000-acre preserve that is only used by community members, that has a dedicated ranger, and that has the most potential for large acreage loss. This IAZ is located in the far eastern portion of the community and has limited access. The other IAZ is composed of the WUI zone adjacent to agriculture plots. This IAZ is more specifically located in and around agricultural areas and those centered in the central and western portions of the community. SPRMIC Fire Department does not protect any other areas as an initial-attack responder. There are no contracts with other agencies for initial-attack responses within the community. Mutual-aid agreements exist between the SRPMIC and the Fort McDowell Yavapai Nation, the City of Mesa, and the City of Scottsdale. There is an MOU between the BIA and the USDA Forest Service for initial attack along the river/preserve areas. This MOU states that both agencies can take initial-attack actions on fires within 1 mile of their shared border if they have been notified of a fire. The responding agency must notify the other agency that it is responding into the other's jurisdiction. Once the host agency has resources on the fire, they must either release the mutual-aid responders or request for extended-attack resources.

General fire occurrence is only available for fiscal year 2000–2001. During that period of time there were 12 fires of less than 20 acres that were managed with the initial-attack resources. All of this fire occurred within the WUI IAZ. Fire season within the unit runs from April through July, with some incidents in October. SRPMIC Fire Department objectives include the following:

- Preserve Zone—to respond and keep fire incidents under 1 acre 90 percent of the time. To respond and keep fire incidents under 5 acres 95 percent of the time.
- Wildland Urban Interface/Agriculture Zone—to respond and keep fire incidents under 1 acre 90 percent of the time. To respond and keep fires incidents under 5 acres 95 percent of the time. To respond to and protect all residential and commercial structures from wildland fire incidents 100 percent of the time.

Within the SRPMIC sub-WUI the areas of highest wildfire risk are located within the Salt River corridor. Vegetation within the riparian corridor can produce intense wildfire within large areas of contiguous heavy vegetative fuels. This portion of the sub-WUI does include areas of moderate risk based on wildfire ignitions in proximity to these riparian corridors. Due to areas of high to moderate wildfire risk, a moderate ignition history, and areas of low-density community values, the overall wildland fire risk rating of the sub-WUI is moderate.

2. Western WUI Communities

Surprise Sub-WUI

The Surprise sub-WUI includes the city of Surprise. Surprise is in the fast-growing northwestern part of the Phoenix Valley, along US 60 and SR 93. White Tank Regional Park, which borders the city to the west, has unusual Indian petroglyphs in its 26,000 acres where camping, hiking, and picnicking are popular activities. Surprise is also home to the world-class retirement community Sun City Grand. The population of Surprise, according to the Arizona Department of Economic Security and the US Census Bureau (2008), is 112,020 people, which is up from 30,848 in 2000. There are 46,975 housing units (39,628 occupied: 32,345 owner occupied; 7,283 renter occupied) in Surprise. Transportation routes into the area are along US 60, SR 93, SR 74, Loop 303, and the Burlington Northern Santa Fe Railroad. The Surprise Fire Department maintains an ISO rating of 3. The Surprise Fire Department does respond to wildland fire threats within the WUI. Areas of highest wildfire risk are located within the Trilby Wash Basin and the Agua Fria river corridor. Vegetation within these riparian areas can produce intense wildfire within large areas of contiguous heavy vegetative fuels. This portion of the sub-WUI does include areas of moderate risk based on wildfire ignitions in proximity to these riparian corridors. Due to areas of high to moderate wildfire risk, a moderate ignition history, and areas of high-density community values, the overall wildland fire risk rating of the sub-WUI is moderate.

El Mirage Sub-WUI

The El Mirage sub-WUI includes the city of El Mirage. El Mirage is a residential community with a pleasant small-town environment on the west bank of the usually dry Agua Fria River. The population of El Mirage, according to the Arizona Department of Economic Security and the US Census Bureau (2008), is 35,332 people, which is up from 7,609 in 2000. There are 10,361 housing units (9,318 occupied: 6,856 owner occupied; 2,462 renter occupied) in El Mirage. Transportation routes into the area are US 60 and the Burlington Northern Santa Fe Railroad. The El Mirage Fire Department responds to wildland fire threats within the WUI. Areas of highest wildfire risk are located within the Agua Fria River corridor. Vegetation within this riparian area can produce intense wildfire within large areas of contiguous heavy vegetative fuels. This portion of the sub-WUI does include areas of low risk based on wildfire ignitions in proximity to the riparian corridor. Due to areas of high to moderate wildfire risk within the riparian corridor, a low ignition history, and areas of primarily low-density community values, the overall wildland fire risk rating of the sub-WUI is low.

Youngtown Sub-WUI

The Youngtown sub-WUI lies between the El Mirage and Peoria sub-WUIs. Youngtown is the nation's oldest retirement community. The population of Youngtown, according to the Arizona Department of Economic Security and the US Census Bureau (2008), is 6,522 people, which is up from 3,010 in 2000. In 2000 there were 1,783 housing units (1,641 occupied: 1,015 owner occupied; 626 renter occupied) in Youngtown. Transportation routes into the area are US 60 and the Burlington Northern Santa Fe Railroad. The Youngtown Fire Department, with an ISO rating of 9, responds to wildland fire threats within the WUI. An area of moderate wildfire risk is located within the Agua Fria River corridor. The Youngtown sub-WUI

consists of less than 10 acres of high wildland fire risk. This portion of the sub-WUI does include areas of low risk based on wildfire ignitions in proximity to the riparian corridor. Due to limited areas of high to moderate wildfire risk within the riparian corridor, a low ignition history, and areas of primarily low-density community values, the overall wildland fire risk rating of the sub-WUI is low.

Peoria Sub-WUI

The Peoria sub-WUI includes the city of Peoria. Peoria is a rapidly growing suburban community. Formerly an agricultural town, today it is a business and medical hub for the Northwest Valley. The population of Peoria, according to the Arizona Department of Economic Security and the US Census Bureau (2008), is 151,693 people, which is up from 108,364 in 2000. There are 58,092 housing units (52,914 occupied: 41,613 owner occupied; 11,301 renter occupied) in Peoria. Transportation routes into the area are I-17, US 60, and Loops 101 and 303. The Peoria Fire Department responds to wildland fire threats within the WUI. Areas of highest wildfire risk are located within the northern portion of the sub-WUI. This area consists of paloverde-mixed cacti vegetation communities and riparian vegetation associated with the Agua Fria River corridor south of SR 74 that can support wildland fire during extraordinary rainfall years and that can produce intense wildfire within large areas of contiguous heavy vegetative fuels. This portion of the sub-WUI does include areas of low risk based on wildfire ignitions in proximity to the riparian corridor. Due to areas of high to moderate wildfire risk within the riparian corridor, a low ignition history, and limited areas of high- to moderate-density community values, the overall wildland fire risk rating of the sub-WUI is low.

Glendale Sub-WUI

The Glendale sub-WUI includes the city of Glendale. Glendale, Arizona's fourth largest city, is the commercial, industrial, and educational hub of the northwest portion of the Phoenix metropolitan area. The population of Glendale, according to the Arizona Department of Economic Security and the US Census Bureau (2008), is 248,435 people, which is up from 218,112 in 2000. There are 85,705 housing units (76,262 occupied: 48,233 owner occupied; 28,029 renter occupied) in Glendale. Transportation routes into the area are I-17, I-10, US 60, Loop 101, and the Burlington Northern Santa Fe Railroad. The Glendale Fire Department, with ISO ratings of 2 and 9, responds to wildland fire threats within the WUI. This area consists primarily of densely developed lands—of which approximately 80 percent of the land cover is impervious surface—but also includes Thunderbird Conservation Park and land adjacent to the White Tank Mountains and Conservation Area. Therefore, the risk of unwanted wildland fire occurring within or immediately adjacent to the municipality is low. This portion of the sub-WUI does not include areas of moderate to high risk based on wildfire ignitions. Due to areas of low wildfire risk, a low ignition history, and limited areas of high- to moderate-density community values, the overall wildland fire risk rating of the sub-WUI is low.

Litchfield Park Sub-WUI

The Litchfield Park sub-WUI includes the city of Litchfield Park. Litchfield Park is a planned residential community boasting a small town atmosphere and casual lifestyle. The population of Litchfield Park, according to the Arizona Department of Economic Security and the US Census Bureau (2008), is 5,093 people, which is up from 3,810 in 2000. In 2000 there were 1,633 housing units (1,508 occupied: 1,313

owner occupied; 195 renter occupied) in Litchfield Park. Transportation routes into the area are I-10. Fire protection is provided to Litchfield through individual subscriptions, as is the protection for the unincorporated areas bounded by 160th Avenue on the west, Pinnacle Peak Road on the north, the Gila River to the south, and 75th Avenue to the east. Fire-response apparatus and personnel include two Type 1 fire engines, one Type 2 fire engine, and one Type 7 fire engine. There are 28 firefighters trained in wildfire response. Litchfield Park has an ISO rating of 3, while the unincorporated areas have an ISO rating of 4/9. Areas of highest wildfire risk are located within the Agua Fria River corridor. Vegetation within this riparian area can produce intense wildfire within large areas of contiguous heavy vegetative fuels. This portion of the sub-WUI does include areas of low risk based on wildfire ignitions in proximity to the riparian corridor. Due to limited areas of high to moderate wildfire risk within the riparian corridor, a low ignition history, and areas of primarily low-density community values, the overall wildland fire risk rating of the sub-WUI is low.

Tolleson Sub-WUI

The Tolleson sub-WUI includes the city of Tolleson. Tolleson, measuring approximately 6 square miles, is a self-contained community west of downtown Phoenix. The population of Tolleson, according to the Arizona Department of Economic Security and the US Census Bureau (2008), is 6,833 people, which is up from 4,974 in 2000. In 2000 there were 1,485 housing units (1,432 occupied: 940 owner occupied; 492 renter occupied) in Tolleson. Transportation routes into the area are I-10 and Loop 101. The City of Tolleson Fire Department responds to wildland fire threats within the WUI. Vegetation within the Tolleson sub-WUI consists of lower-elevation desert scrub types adjacent to areas of dense development. These vegetative communities and densely developed areas do not normally support wildland fire; therefore, the potential of unwanted wildland fire is low. This portion of the sub-WUI includes areas of low risk based on wildfire ignitions in proximity to the I-10 corridor. Due to low wildfire risk, a low ignition history, and areas of primarily moderate-density community values along the I-10 corridor, the overall wildland fire risk rating of the sub-WUI is low.

Avondale Sub-WUI

The Avondale sub-WUI includes the city of Avondale. Nestled at the base of the scenic Estrella Mountains where the Agua Fria and Gila rivers meet, Avondale is on the I-10 and the Loop 101 corridors, just a 15-minute commute from the heart of Phoenix. The population of Avondale, according to the Arizona Department of Economic Security and the US Census Bureau (2008), is 76,648 people, which is up from 35,883 in 2000. There are 23,237 housing units (20,345 occupied: 13,819 owner occupied; 6,526 renter occupied) in Avondale. Transportation routes into the area are I-10 and Loop 101. The Avondale Fire Department, with ISO ratings of 4 and 9, responds to wildland fire threats within the WUI. Areas of highest wildfire risk are located within the Agua Fria river corridor. Vegetation within these riparian areas can produce intense wildfire within large areas of contiguous heavy vegetative fuels. This portion of the sub-WUI does include areas of low risk based on wildfire ignitions in proximity to these riparian corridors. Due to areas of high to moderate wildfire risk, a moderate ignition history, and areas of high-density community values, the overall wildland fire risk rating of the sub-WUI is moderate.

Goodyear and Management Areas 7, 8, and 9 Sub-WUI

The Goodyear sub-WUI includes the city of Goodyear. Management Area 9 includes the area of the Pinal-Maricopa County border immediately south of I-8, including the Table Top Wilderness area and the primarily agricultural lands associated with the Pinal County community of Stanfield. Management Area 8 includes the Vekol Wash area from I-8 to north along the eastern boundary of the South Maricopa Mountain Wilderness area. Management Area 8 also includes the landfill site to the west of the community of Mobile and the Goodyear city limits. Management Area 7 includes the Waterman Wash area and the Rainbow Valley area along the western edge of the Estrella Mountain Regional Park. Goodyear is a suburban community southwest of metro Phoenix and was founded by Goodyear Tire/Rubber Co. for the farming of cotton. The population of Goodyear, according to the Arizona Department of Economic Security and the US Census Bureau (2008), is 59,436 people, which is up from 18,911 in 2000. There are 20,854 housing units (18,721 occupied: 15,231 owner occupied; 3,490 renter occupied) in Goodyear. Transportation routes into the area are I-10 and SR 85. In 2007, Mobile was annexed into the city of Goodyear as part of a 67-square-mile expansion, part of an agreement with Montage Holdings, a local developer, to develop a master-planned community in the area. The master-planned community named Amaranth—envisioned as a self-sustaining community with a regional mall, employment centers, and eventually home to over 50,000 people—has been placed on hold until at least 2010 due to the economic slowdown. The delay, as well as the developer's inability to meet financial obligations to the City, has forced Goodyear to cut back on emergency services to the area. Transportation routes into the area are SR 238. The Goodyear Fire Department responds to wildland fire threats within the WUI. Guadalupe Fire Department also responds to wildland fire within the vicinity of Mobile through an automatic-aid agreement with the City of Goodyear. The area at highest risk for wildland fire within the WUI occurs within the Gila River riparian corridor, near the Waterman Wash confluence with the Gila River. Vegetation within the Gila River riparian corridor is composed of areas that are heavily infested with saltcedar. Saltcedar-infested riparian vegetation can produce intense wildfire within large areas of contiguous heavy vegetative fuels, sending fire brands in excess of 700 feet in front of the headfire. This portion of the sub-WUI includes areas of low risk based on wildfire ignitions in proximity to the Gila River riparian corridor. Due to limited areas of high to moderate wildfire risk, low ignition history, and areas of moderate- to high-density community values, the overall wildland fire risk rating of the sub-WUI is moderate.

Gila River Indian Community and St. Johns 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 St. Johns is listed as moderate risk within the *Arizona-Identified Communities at Risk* (Arizona State Forester 2009) and is located adjacent to the Gila River within the Gila River sub-WUI. St. Johns is adjacent to the Gila River near the confluence with the Santa Cruz Wash. Census data for the St. Johns area was not readily available; the population of the zip code that includes the St. Johns area (85326) is 22,019. There are 6,245 housing units (5,774 occupied: 4,290 owner occupied; 1,484 renter occupied) in the zip code. Transportation routes into the area are Beltline Road, 51st Avenue, and I-10.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 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 and Santa Cruz Wash riparian corridors that have 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 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.

Wickenburg Sub-WUI

The Wickenburg sub-WUI includes the town of Wickenburg and surrounding areas within the WUI. Wickenburg lies in the foothills of the Bradshaw Mountains, along the banks of the Hassayampa River. The population of Wickenburg, according to the Arizona Department of Economic Security and the US Census Bureau (2008), is 6,442 people, which is up from 5,082 in 2000. In 2000, there were 2,691 housing units (2,341 occupied: 1,519 owner occupied; 822 renter occupied) in Wickenburg. Transportation routes into the area are US 60, SR 93, and the Burlington Northern Santa Fe Railroad. The Wickenburg Fire Department maintains an ISO rating of 4 within the municipal water system, an area of approximately 21 square miles. The remainder of the fire department service area is beyond the “1,000-foot distance from a water hydrant” range and has an ISO rating of 8b. The Wickenburg Fire Department service area covers 88 square miles within and adjacent to the town, within the counties of Maricopa and Yavapai. The portion of the fire department’s service area within Yavapai County is included within the Yavapai County CWPP. The Wickenburg Fire Department does respond to wildland fire threats within the WUI. The area at highest risk for wildland fire within the WUI occurs within the Hassayampa River riparian corridor. Vegetation within the Hassayampa River riparian corridor is composed of extensive riparian woodlands. Some areas within the Hassayampa River have become heavily infested with saltcedar. Saltcedar-infested riparian vegetation can produce intense wildfires within large areas of contiguous heavy vegetative fuels, creating extreme wildland fire behavior. This portion of the sub-WUI includes areas of moderate risk based on wildfire ignitions in proximity to the Hassayampa River riparian corridor. Due to limited areas of high to moderate wildfire risk, low ignition history, and areas of moderate-density community values, the overall wildland fire risk rating of the sub-WUI is moderate.

Buckeye, Management Area 1, Management Area 4 (Buckeye Hills Recreation Area), and Management Area 10 (White Tank Mountain Regional Park) Sub-WUI

The Buckeye sub-WUI includes the town of Buckeye, located at the confluence of the Gila and Hassayampa rivers, and spans approximately 650 square miles of incorporated mixed land use. This sub-WUI also includes the area within and adjacent to the White Tank Mountain Regional Park, unincorporated areas to the northwest of the municipal boundary, and the Buckeye Hills Regional Park. The population of Buckeye, according to the Arizona Department of Economic Security and the US Census Bureau (2008), is 50,143 people, which is up from 8,497 in 2000. There are 11,256 housing units (10,161 occupied: 7,457 owner occupied; 2,704 renter occupied) in Buckeye. The Buckeye sub-WUI includes the Palo Verde Nuclear Generating Station. Emergency evacuation of the nuclear-generating station will include Maricopa County Road 85, within the Buckeye sub-WUI. Transportation routes into the area are I-10 and SR 85 and the Union Pacific Railroad. The Buckeye Valley area is included within the *Arizona-Identified Communities at Risk* (Arizona State Forester 2009) to be at a moderate risk of wildland fire. The Buckeye Fire Department maintains an ISO rating of 4 within the incorporated master-planned communities and town limits. Areas within the Buckeye sub-WUI that are undeveloped open land, including BLM and State Trust lands, have an ISO rating of 9. The Buckeye Fire Department responds to several brush and grass fires annually. From January 2001 to October 2009 the fire department responded to 292 grass- and brush-related fires. The highest incidents occurred during the extreme fire year of 2005 when the fire department responded to 54 wildland fires. The highest wildland fire risk within the sub-WUI is related to the Gila, Hassayampa, Agua Fria, and New River riparian corridors that have 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 areas of generally low upland and high riparian wildfire risk, limited areas of moderate to high ignition history, and a low to moderate density of community values, the overall wildland fire risk rating of the sub-WUI is moderate.

Buckeye Valley, Management Area 5 Sub-WUI

This sub-WUI includes the area to the west of the municipality of Buckeye along the Hassayampa River corridor and south along the western uplands of the Gila River corridor, including agricultural areas north of the community of Gila Bend. The Buckeye Valley area is included within the *Arizona-Identified Communities at Risk* (Arizona State Forester 2009) to be at a moderate risk of wildland fire. This is an area of limited development and sparsely populated. The highest area of wildland fire risk in Buckeye Valley includes uplands and agricultural areas within the Gila River riparian corridor. The majority of the sub-WUI has a low wildland fire risk, low wildland fire ignition history, a low density of community values; the overall wildland fire risk rating of the sub-WUI is moderate.

Gila Bend, Tohono O'odham Nation San Lucy District, Management Area 6 (Painted Rock Wildlife Area) Sub-WUI

The Gila Bend sub-WUI is on a desert plain in southwestern Maricopa County and includes the town of Gila Bend, the Tohono O'odham Nation San Lucy District and the Painted Rock Wildlife Area, located near a sharp bend in the Gila River. This sub-WUI includes upland areas north of the community along SR 85, agricultural areas within the Gila Bend Valley, west to the Painted Rock Wildlife area, the Gila River riparian corridor and upland agricultural areas adjacent to I-8. The population of Gila Bend, according to the Arizona Department of Economic Security and the US Census Bureau (2008), is 1,899 people, which is down from 1,980 in 2000. In 2000 there were 766 housing units (659 occupied: 384 owner occupied; 275 renter occupied) in Gila Bend. Transportation routes into the area are I-8, SR 85, and the Union Pacific Railroad. The San Lucy District of the Tohono O'odham Indian Nation is located adjacent to the Town of Gila Bend. The San Lucy District has a tribal enrollment of 1,850 persons with 625 living on the reservation (www.tonation-nsn.gov/districts.aspx, accessed January 2010). The Gila Bend Volunteer Fire Department responds to wildland fire threats within the WUI. The Gila Bend area is included within the *Arizona-Identified Communities at Risk* (Arizona State Forester 2009) to be at a moderate risk of wildland fire. 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 commonly move in excess of 700 feet in front of the headfire. The Gila Bend sub-WUI does have a history of moderate to high numbers 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 areas of generally low upland and high riparian wildfire risk, limited areas of moderate to high ignition history, and a low to moderate density of community values, the overall wildland fire risk rating of the sub-WUI is moderate.

Aguila Sub-WUI

Aguila is a small unincorporated community in Maricopa County. It is located on US 60 approximately 20 miles west of Wickenburg, or at approximately 50000 N. 510th Avenue. Major economic activities include cantaloupe farming and formerly included mining. Aguila uses the same street numbering system as Phoenix. Aguila is included in the 85320 zip code. The population was 1,064—including 753 total housing units, of which 293 were single-family homes—as of the 2000 census. Fire protection is provided to the residents by the Aguila Fire District. The Aguila sub-WUI within the Maricopa County CWPP analysis area does not include high wildland fire risk acres. Vegetation within this sub-WUI is primarily paloverde-mixed cacti association, which during extraordinary rainfall years can support wildland fire. This portion of the sub-WUI includes areas of low risk based on wildfire ignitions in proximity to the riparian corridor. Due to areas of low wildfire risk, a low ignition history, and areas of primarily low-density community values, the overall wildland fire risk rating of the sub-WUI is low.

Apache Junction Sub-WUI

Apache Junction is a rural community located along US 60 approximately 30 miles east of Phoenix. US 60 is the major transportation route into this community; SR 77 also serves as a transportation route into 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. A small area of Apache Junction is located within Maricopa County. The majority of Apache Junction is included with the Pinal County CWPP. In accordance with that analysis the overall wildland fire risk rating for Apache Junction is moderate. For additional information on the wildland fire analysis for this sub-WUI, refer to the 2009 Pinal County CWPP.

Circle City/Morristown Sub-WUI

Circle City is an unincorporated community in Maricopa County. It derives its name from the Workmen's Circle, a Jewish fraternal organization formed during the early twentieth century. It is located 14 miles northwest of Surprise, Arizona, on US 60 within the 85361 zip code area. As of 2000 it had a population of 4,147 residents and 1,511 total housing units, of which 401 are single-family homes. The Circle City/Morristown Volunteer Fire Department provides fire protection to the residents of this sub-WUI. The Circle City/Morristown sub-WUI is composed primarily of paloverde-mixed cacti and creosotebush-bursage vegetation associations that do not, under normal circumstances, support wildland fire. This portion of the sub-WUI includes areas of low risk based on wildfire ignitions. Due to limited areas of low wildfire risk, low ignition history, and areas of a low density of community values, the overall wildland fire risk rating of the sub-WUI is low.

Harquahala, Management Area 3 Sub-WUI

This sub-WUI is in the unincorporated community of Harquahala, west of Phoenix. The Harquahala Fire District covers 432 square miles, including a 20-mile stretch of the I-10. The Harquahala Fire District has 12 full-time firefighters, aided by paid on-call reserves, and 3 administrative members. Harquahala Fire District uses a 48-hour-on/96-hour-off rotation schedule with an A, B, and C shift to ensure the safety and security of residents within the district. The Harquahala Fire District handles all medical issues, fires, hazardous material incidents, vehicle extractions, and other calls for assistance as needed within the district. Additionally, the department serves as needed for backup on large incidents on the mutual-aid system. The Harquahala sub-WUI is composed primarily of paloverde-mixed cacti and creosotebush-bursage vegetation associations that do not, under normal circumstances, support wildland fire. Limited areas of moderate to high wildfire risk occur along the I-10 corridor at the La Paz–Maricopa County boundary. This portion of the sub-WUI includes areas of low risk based on wildfire ignitions. Due to limited areas of low wildfire risk, low ignition history, and areas of a low density of community values, the overall wildland fire risk rating of the sub-WUI is low.

Sun Lakes Sub-WUI

Sun Lakes is a 3,500-acre master-planned community for active adults. Located 7 miles south of Chandler in metropolitan Phoenix, Sun Lakes offers a small-town atmosphere with world-class resort amenities. Established in 1972 by Edward J. Robson of Robson Communities, Sun Lakes is home to more than

15,000 residents who enjoy an active, healthy lifestyle. The exceptional quality of life available at Sun Lakes has been recognized locally and nationally. *New Choices Magazine*, a Reader's Digest publication, has listed Sun Lakes as one of the "Top 20 Retirement Communities in America" for the past several years. The majority of the residents of Sun Lakes are retired, and income is derived from social security, stocks and bonds, investments, and savings. The surrounding communities are a center for the high-tech industry. Motorola and Intel have four plants in the area. Other high-tech industries include Rogers, Avnet, Aircraft Gear, ST Microwave, Orbital Sciences, and Microchip Technology. The population of Sun Lakes, according to the Arizona Department of Economic Security and the US Census Bureau (2000), is 11,936 residents—a significant increase from the 6,578 residents reported in 1990. In 2000 there were 7,746 total housing units, of which 5,472 were single-family homes. The major transportation route into the area is I-10. The Sun Lakes Fire District, which has an ISO rating of 3, responds to wildland fire threats within the WUI. Sun Lakes Fire District has a formal agreement with ASLD to provide labor and resources when needed for wildland fire suppression within the state. The Sun Lakes sub-WUI is composed primarily of paloverde-mixed cacti and creosotebush-bursage vegetation associations that do not, under normal circumstances, support wildland fire. This portion of the sub-WUI includes areas of low risk based on wildfire ignitions. Due to limited areas of low wildfire risk, low ignition history, and areas of low-density community values, the overall wildland fire risk rating of the sub-WUI is low.

Sun City Sub-WUI

Sun City is the quintessential retirement community, known for the active lifestyle of its senior citizens. There are over 350 clubs and civic organizations and 7 recreation centers. Sun City began as a partnership between builder Del Webb and cotton farmer J. G. Boswell who owned the land. It opened on New Year's Day in 1960 with a three-bedroom, two-bath house selling for $11,300. The community was an instant success; 237 homes were sold in the first three days. Sun City deed restrictions require that at least one resident per household be 55 years or older. It encompasses 8,900 acres, of which 1,200 are golf courses, making it a "golfers' paradise." The electric golf cart is a favorite form of transportation. Sun City residents are almost all retired, and income derives from social security, stocks and bonds, investments, and savings. Annual income is estimated at $1 billion, and net worth at $8 billion. Residents spend about $300 million annually for local goods and services. Employment is found in several shopping centers, numerous restaurants, service centers, and real estate companies. Its taxes are one-half to two-thirds lower than in most other area communities. The Sun City Fire Department provides fire protection to the residents of Sun City sub-WUI. The population of Sun City, according to the Arizona Department of Economic Security and the US Census Bureau (2000), is 38,309 residents, a fairly stable population compared with the 38,128 residents reported in 1990. In 2000 there were 27,731 total housing units, of which 18,101 were single-family homes. The major transportation route into the area is US 60. The Sun City sub-WUI is composed primarily of paloverde-mixed cacti and creosotebush-bursage vegetation associations that do not, under normal circumstances, support wildland fire. This portion of the sub-WUI includes areas of low risk based on wildfire ignitions. Due to limited areas of low wildfire risk, low ignition history, and areas of a low density of community values, the overall wildland fire risk rating of the sub-WUI is low.

Sun City West Sub-WUI

The community of Sun City West, about 12 miles northwest of Phoenix, is a master-planned active-adult community for people 55 years of age and over. The community began in 1978 when all available land in the community of Sun City, which is 2 miles east, was built upon. The community, together with Sun City, has been rated the third best location out of 100 top-rated retirement communities in the nation. Over 32,000 residents now call the built-out retirement community of Sun City West home. The majority of the residents in the community of Sun City West are retired and income is derived from social security, stocks and bonds, investments, and savings. The population of Sun City West, according to the Arizona Department of Economic Security and the US Census Bureau (2000), is 26,344 residents, an increase in population from the 15,997 residents recorded by the 1990 census. In 2000, there were 17,359 total housing units (659 occupied: 384 owner occupied; 275 renter occupied), of which 13,374 were single-family homes. The major transportation routes into the area are US 60 and the SR Loop 303. The Burlington Northern Santa Fe Railroad also passes through the community.

Fire protection is provided to the property owners of the community of Sun City West and other adjacent areas of unincorporated Maricopa County by the Sun City West Fire District. The district has an ISO rating of 2. The district has one Type 6 and two Type 1 fire engines with wildland/brush response capabilities. The district maintains a wildland firefighting team that responds to wildfires on state and federal lands. The team is composed of 10 members who train year-round for wildland fire suppression as a specialty group. Each frontline firefighter outside the wildland fire team is also given annual refresher training in wildland fire response. The Sun City West Fire District recently annexed a large land area which has increased the community WUI. The Sun City West Fire District population is now estimated at 45,000 residents with a response area of over 35-square-miles.

Areas of highest wildfire risk are located within the Trilby Wash Basin and the Agua Fria river corridor. Portions of the District's newly annexed areas include sizeable wildland-urban interface concerns including residential structures as well as mining and gravel operations located within the Agua Fria river corridor. Vegetation within these riparian areas can produce intense wildfire within large areas of contiguous heavy vegetative fuels. This portion of the sub-WUI does include areas of moderate risk based on wildfire ignitions in proximity to these riparian corridors. Due to areas of high to moderate wildfire risk, low ignition history, and areas of moderate- to high-density community values, the overall wildland fire risk rating of the sub-WUI is moderate.

Tonopah Valley, Management Area 2 Sub-WUI

Tonopah is surrounded by mountains to the north (Belmont Mountains), west (Saddle Mountain), and south (Palo Verde Hills) and opens to the east into the Hassayampa River. The mountains are of volcanic origin and are formed of a similar material, which underlies the Tonopah Basin. One of the outstanding features of the area is the thermal water, which led to the construction of hot-bath houses in the 1930s. Mining became popular in the 1920s when the Belmont Mine opened. The first school was built in 1929. In 1951, the area's first cotton crops were planted in the area that is now downtown Tonopah. Area employment includes the Palo Verde Nuclear Generating Station and farming and agriculture. Wal-Mart (bulk storage and packaging) and Schult Homes (manufactured housing) in nearby communities also provide

employment. The town is located in the Maricopa County Westside Enterprise Zone, which offers income tax credits and other incentives (up to $5,000 per employee) for companies locating or expanding into the zone. There are several areas surrounding Tonopah that offer hiking, hunting, bird watching, and other scenic and recreational opportunities. Visitors can chose from three wilderness areas, visit the El Dorado Hot Springs, or hike along Saddle Mountain. Each year the community holds an annual Spring Fling, Fourth of July celebration, and a winter carnival. The Tonopah Valley Fire District provides fire protection to the residents of this sub-WUI. Census data for the Tonopah Valley sub-WUI is not directly available. The major transportation route into the area is I-10 and Buckeye Road. The Tonopah Valley sub-WUI is composed primarily of paloverde-mixed cacti and creosotebush-bursage vegetation associations that do not, under normal circumstances, support wildland fire. This portion of the sub-WUI includes areas of low risk based on wildfire ignitions. Due to limited areas of low wildfire risk, low ignition history, and areas of a low density of community values, the overall wildland fire risk rating of the sub-WUI is low.

Wittmann Sub-WUI

Wittmann is a small unincorporated community in Maricopa County, located along US 60 in the central part of Arizona, about 35 miles northwest of central Phoenix. Although it is technically located within the Phoenix metropolitan area, it is generally regarded by locals to be just outside of it. According to the 2000 census, 4,174 residents were recorded as living within the 85361 zip code and thus having a Wittmann address. There are 1,511 total housing units, of which 401 are single-family homes. Wittmann does not have any official or census-designated boundaries. Wittmann is located in an area of rapid growth, and the locale has suffered from numerous growing pains. The Nadaburg Elementary School District located in Wittmann, which had long been considered a small rural school, was forced to construct a larger, modernized school in 2004 to accommodate the influx of students; the district is already planning for a second school nearby. Increased traffic along US 60 necessitated a widening of the highway. The highway's location parallel to the Burlington Northern Santa Fe Railroad tracks unfortunately meant that the widening would claim a number of homes and local businesses, including the only prominent service station between Phoenix and Wickenburg, as well as the community's landmark overpass footbridge servicing the elementary school. Past efforts to incorporate the community failed largely due to opposition from local landowners, and thus there has been no real local government or planning agency. The nearby City of Surprise has in recent years annexed much of the land near and around the town, and has included it as part of its general plan. Fire protection is provided by the Wittmann Fire District. The Wittmann sub-WUI is composed primarily of paloverde-mixed cacti and creosotebush-bursage vegetation associations that do not, under normal circumstances, support wildland fire. This portion of the sub-WUI includes areas of low risk based on wildfire ignitions. Due to limited areas of low wildfire risk, low ignition history, and areas of a low density of community values, the overall wildland fire risk rating of the sub-WUI is low.

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 Figures 2.8a and 2.8b 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

Maricopa County CWPP community sub-WUI	High risk (%)	Acres	Moderate risk (%)	Acres	Low risk (%)	Acres	Total acres
Aguila	0	0	17	728	83	3,692	4,420
Apache Junction							3,239*
Wickenburg	<1	34	34	12,837	65	24,338	37,209
Circle City/Morristown	<1	42	45	23,029	55	28,648	51,719
Buckeye	2	6303	66	190,471	32	92,722	289,497
Peoria	3	3,994	44	69,920	53	82,569	156,483
Chandler	1	568	29	12,317	70	30,356	43,241
Tonopah Valley	1	601	72	69,087	27	26,180	95,868
El Mirage	3	228	19	1,392	78	5,709	7328
Buckeye Valley	0	0	73	56,010	27	20,692	76,703
Gila Bend	1	1,015	73	65,602	26	23,719	90,336
Harquahala	1	1,247	74	91,175	25	31,015	123,436
Goodyear	1	998	70	112,438	29	47,723	161,159
Youngtown	1	8	25	374	74	1,123	1,503
Gila River Indian Community	24	42,324	53	94,066	23	39,725	176,114
Phoenix	5	18,568	44	157,858	51	185,007	361,433
Cave Creek	0	0	52	16,437	48	15,122	31,560
Sunflower	18	4,536	65	16,033	17	4,252	24,820
Scottsdale	4	5,642	58	72,237	38	48,307	126,185
Tempe	<1	5	13	3,062	87	20,832	23,989
Rio Verde	18	5,740	58	18,744	24	7,616	32,100

Continued

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

Maricopa County CWPP community sub-WUI	High risk (%)	Acres	Moderate risk (%)	Acres	Low risk (%)	Acres	Total acres
Mesa	3	4,012	40	46,981	57	67,805	118,798
Gilbert	<1	191	29	14,013	71	34,228	48,432
Guadalupe	0	0	1	10	99	689	699
Queen Creek	1	254	36	9,032	63	15,895	25,181
Carefree	<1	37	67	3,952	33	1,938	5,927
Paradise Valley	1	133	51	5,409	48	5,037	10,579
Fountain Hills	1	116	63	7,836	36	4,563	12,515
Salt River Pima-Maricopa Indian Community	5	2,968	57	32,475	38	21,866	57,309
Avondale	6	2,585	63	27,968	31	13,983	44,537
Litchfield Park	7	164	31	659	62	1,360	2,183
Glendale	4	2,199	25	15,666	71	43,882	61,747
Fort McDowell Indian Community	11	2,834	42	10,355	48	11,937	25,126
Surprise	3	2,670	63	48,967	33	25,898	77,535
Sun City	1	120	9	726	90	8,254	9,100
Sun City West	7	1310	46	8004	47	8203	17,517
Sun Lakes	5	210	29	1,121	66	2,533	3,864
Tonto Hills	11	55	19	87	70	338	480
Tolleson	<1	11	69	2,727	30	1,230	3,967
Wittmann	1	189	91	14,547	8	1,308	16,044
New River	5	3,769	45	36,469	50	40,568	80,807
Management Area 1	2	816	78	27,502	20	7,116	35,433

Continued

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

Maricopa County CWPP community sub-WUI	High risk (%)	Acres	Moderate risk (%)	Acres	Low risk (%)	Acres	Total acres
Management Area 2	2	1,385	84	60,714	14	10,110	72,209
Management Area 3	0	0	72	37,765	36	19,006	52,771
Management Area 4	0	0	72	19,636	28	7,677	27,313
Management Area 5	0	0	74	21,261	26	7,514	28,775
Management Area 6	<1	70	57	50,048	42	36,691	86,810
Management Area 7	0	0	84	18,934	16	3,655	22,589
Management Area 8	0	0	78	44,611	22	12,791	57,402
Management Area 9	1	322	38	17,129	61	27,541	44,992
Management Area 10	3	1,197	82	37,155	15	6,547	44,898
Management Area 11	1	513	79	31,179	20	7,730	39,422
Management Area 12	2	270	49	11,118	49	11,095	22,483
Total*	4	120,252	57	1,749,492	39	1,202,717	3,072,461

Source: Logan Simpson Design Inc.

*Treatment areas not equal to area risk assessment due to data-rounding errors.

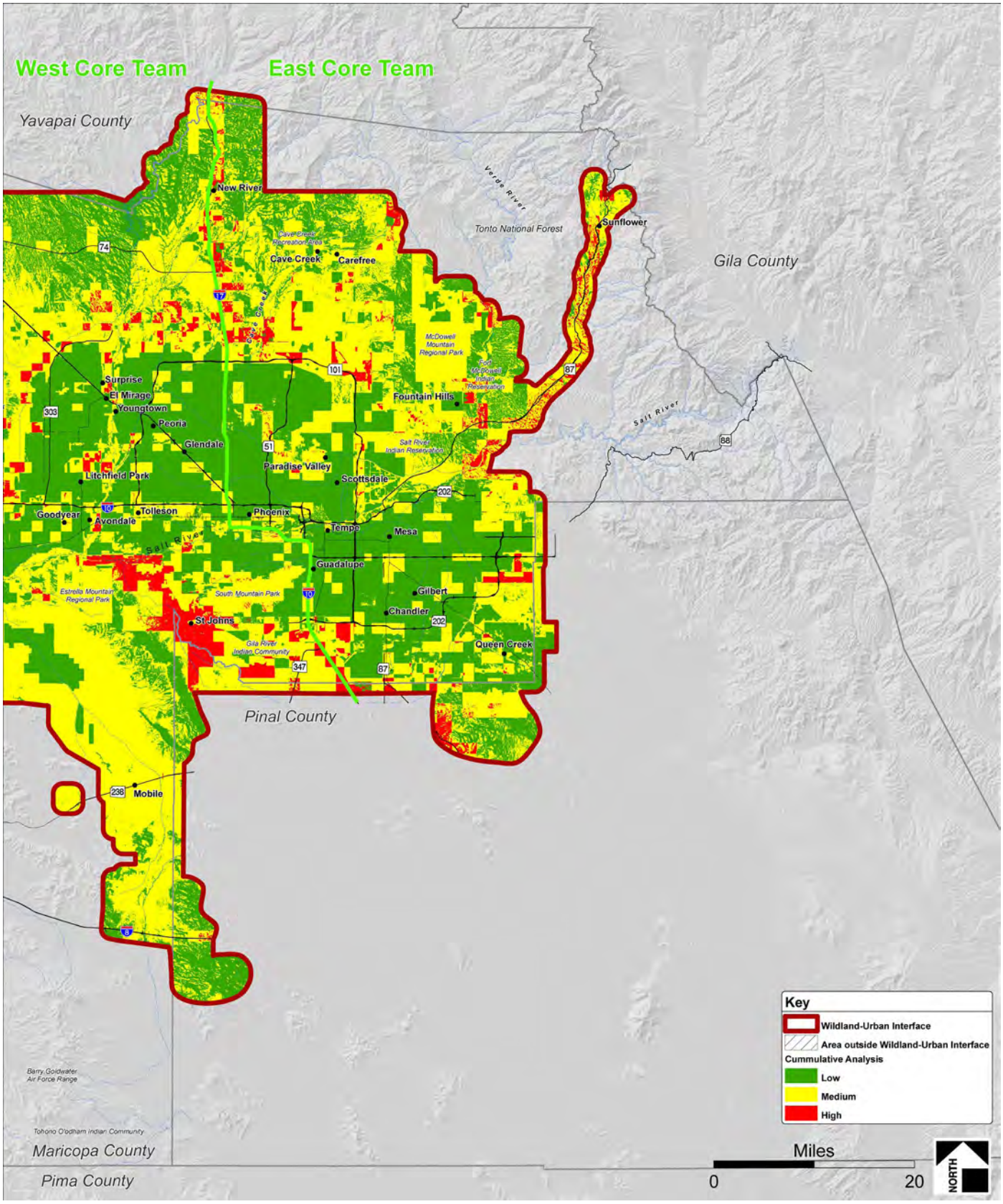

Figure 2.8a. Maricopa County CWPP cumulative risk analysis, east

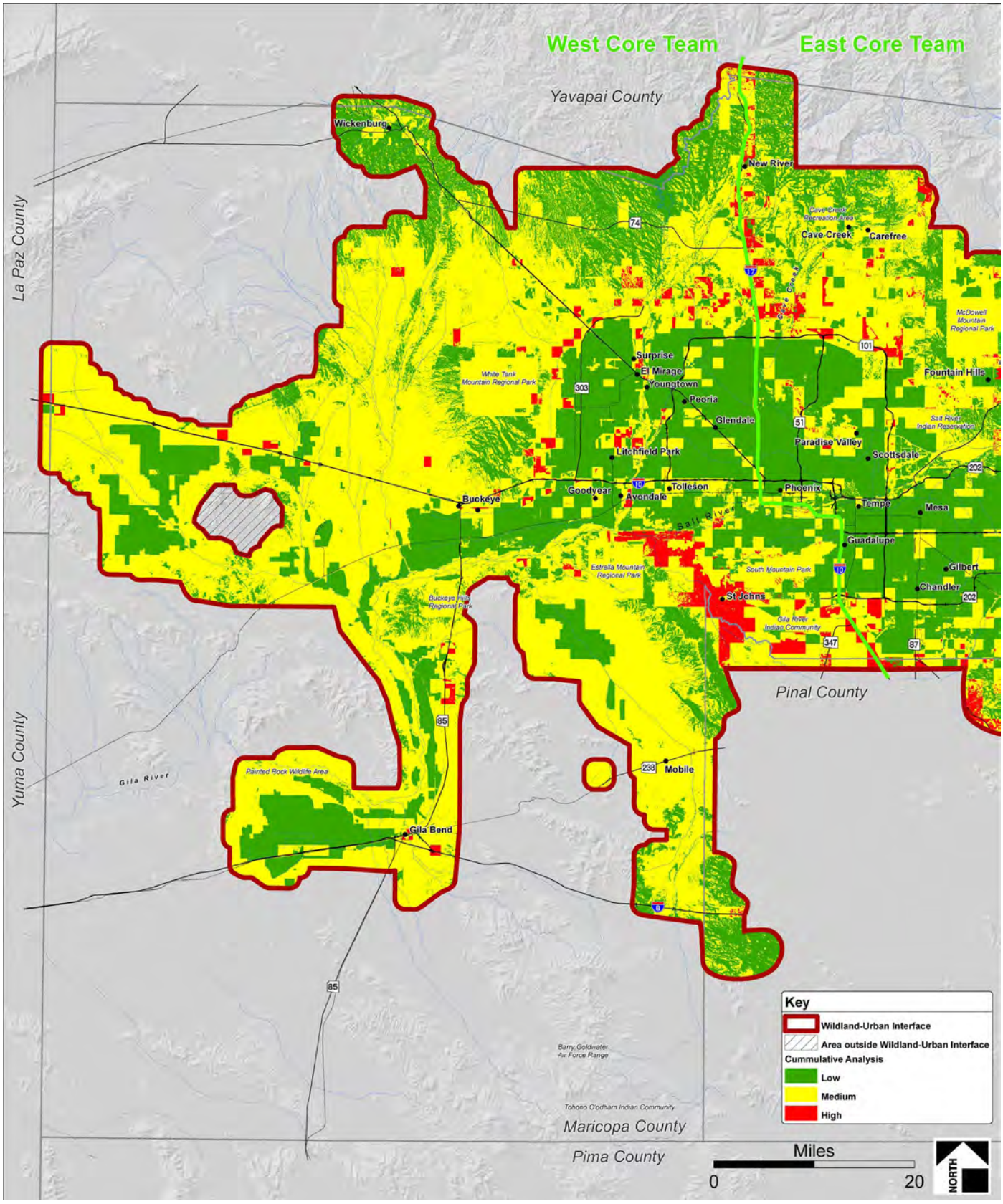

Figure 2.8b. Maricopa County CWPP cumulative risk analysis, west

III. COMMUNITY MITIGATION PLAN

This section outlines Maricopa 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, tribal trust, 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 Maricopa 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 MCDEM, ASFD, TNF, BLM, 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 Maricopa County CWPP WUI: North and South Maricopa Mountains, Sierra Estrella, Hummingbird Springs, Big Horn Mountains, Signal Mountains, Woolsey Peak, Mazatal, Four Peaks, and Superstition 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 and TNF to use appropriate management response (Appendix F).

Table3.1. Fuel modification and treatment plans

Treatment No.	1 Developed private parcels <2 acres				2 Undeveloped private parcels or single-structure parcels >2 acres		3 Grassland firebreaks		4 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. Remove and destroy insect-infested, diseased, and dead trees and shrubs. Grasses and forbs may be cut with a mower to a 4-inch stubble. 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. Create separation between trees, tree crowns, and other plants based on fuel type, density, slope, and other topographical features. Reduce continuity of fuels by creating a clear space around brush or planting groups. Grasses and forbs may be cut with a mower to a 4-inch stubble. 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. Maximum density of trees (whichever is greater: 60 BA at 80–100 trees/acre *or* average density of 100 trees/acre). Grasses and forbs may be cut with a mower to a 4-inch stubble.	For natural areas, thin selectively and remove highly flammable vegetation. 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. Maximum density of trees (whichever is greater: 60 BA at 80–100 trees/acre *or* average density of 100 trees/acre) 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. 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. Areas should be hand-thinned and hand-piled; inaccessible areas may be treated with periodic Rx. 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. 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. Mechanical/chemical or grazing treatment may be used to maintain firebreaks on private lands. 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. 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 to produce 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. 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 and thus create downstream jams. 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. 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. 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. Mechanical treatments may include chipping, piling and burning, or removal and Rx in the project area. 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. Escape and resource transportation corridors may serve as firebreaks in all vegetative types. 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. Emphasis will be placed on removing nonnative and flammable species. 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. 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. 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). Treatments will emphasize nonnative species. Snags >8 inches may be retained. All presettlement trees, including snags, will be targeted for retention. 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. 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. 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.

The wildland vegetative fuel and firebreak recommended treatments meet the Maricopa 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 base map depicting areas of low-, moderate-, and high-risk evaluations (see Figures 2.8a and 2.8b). These risk areas were further identified and categorized into a total of 112 management site-specific areas (treatment management units) of the WUI, with an overall risk value determined for each management unit (Figures 3.1a and 3.1b).

The Core Teams described the location of each treatment management unit in the WUI and then assigned recommended treatments for each unit (Table 3.2).The management units 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 Harquahala community sub-WUI is much larger than the fire district bounday, and wildfire management areas are not in any fire departments or districts or under FS jurisdiction for fire protection; therefore, no fire departments or districts are responsible for that community's treatment management.

Table 3.2. Identified treatment management units

Treatment management unit	Map ID	Risk value	Location and description	Recommended treatment[a]	Total acres	Federal acres	State Trust acres	Nonfederal acres	Tribal acres
Avondale	AD1	M	City of Avondale north and south of I-10	1,2,3,4,7,9	25,856	424	3,861	21,388	184
	AD2	M	Lands south of AD1, including portions of Estrella Mt. Park	1,2,3,8	8,958	2	2,631	2,273	6,325
Aguila	AG1	L	Lands immediately west of Wickenburg boundary	1,2,3,8,9	4,760	0	4,271	490	0
Apache Junction[b]	AJ1	L	Municipal boundary of Apache Junction in Maricopa County	1,2,3	3,329				
Buckeye	BE1	M	Lands in the NE corner of the municipal boundary	1,2,3,4,7,8,9	56,203	13,989	4,341	37,368	0
	BE2	M	Lands north of, and adjacent to, west boundary of White Tank Mt. Regional Park	1,2,3,4,7,8,9	48,435	1,672	14,469	32,295	0

Continued

Table 3.2. Identified treatment management units

Treatment management unit	Map ID	Risk value	Location and description	Recommended treatment[a]	Total acres	Federal acres	State Trust acres	Nonfederal acres	Tribal acres
	BE3	M	Lands NE of community center	1,2,3,4,7,8,9	41,963	1,843	6,261	33,859	0
	BE4	M	Lands NE of town and south of White Tank Mt. Regional Park	1,2,3,7,9	40,655	10,861	10,546	19,248	0
	BE5	L	Lands SW of town and north of Gila River, including Palo Verde Nuclear Generating Station	1,2,3,6,8	23,306	0	1,740	21,566	0
	BE6	L	Lands SE of town, north of Gila River	1,2,3,8	25,684	0	1,257	24,427	0
	BE7	L	Lands SE of town, including Gila River	1,2,3,4,5,6, 7, 9	28,798	5,289	1,511	21,998	0
	BE8	M	Lands south of Buckeye Hills Regional Park within and east of Gila River	1,2,3,4,5,6, 7, 9	25,818	7,182	4,727	13,909	0
Buckeye Valley	BV1	M	Lands west of the town of Buckeye adjacent to Hassayampa River	1,2,3,4,5,6, 7, 8,9	36,681	357	12,133	25,191	0
	BV2	L	Lands SE of Buckeye adjacent to north boundary of Buckeye Hills Regional Park	1,2,3,4,5,6, 7, 8,9	13,329	1,746	78	11,505	0
	BV3	M	Lands west of Buckeye Regional Park, including Gila and Hassayampa River confluence	1,2,3,4,5,6, 7, 8,9	26,893	11,304	5,980	9,609	0
Cave Creek	CC1	M	Town of Cave Creek, Cave Creek Recreation Area, north to TNF boundary	1,2,3,4,5,8	24,043	2,718	8,.556	12,769	0
	CC2	L	Lands NE of Cave Creek to TNF boundary	1,2,3,4,5, 8	7,551	2,424	676	4,452	0

Continued

Table 3.2. Identified treatment management units

Treatment management unit	Map ID	Risk value	Location and description	Recommended treatment[a]	Total acres	Federal acres	State Trust acres	Nonfederal acres	Tribal acres
Circle City/ Morristown	CCMT1	L	Town of Circle City/Morristown and immediate surrounding lands	1,2,3,4,5, 8	52,608	9,100	28,723	14,785	0
Carefree	CF1	M	Town of Carefree and immediate surrounding lands	1,2,3,4,5, 8	5,927	0	79	5,849	0
Chandler	CH1	L	Municipality of Chandler	1,2,3	43,241	0	90	43,151	0
El Mirage	EL1	L	Municipality of El Mirage	1,2,3	7,328	66	3	7,259	0
Fountain Hills	FH1	M	Town of Fountains Hills	1,2,3,4,8	12,515	0	0	12,486	29
Fort McDowell Indian Community	FMD1	M	Tribal trust lands of Fort McDowell Indian Community	1,2,3,4,7,8,9	25,126	76	42	152	24,855
Gila Bend	GB1	M	Lands SE of Gila Bend south of I-8	1,2,3,4,5,8	20,877	12,719	1,306	6,852	0
	GB2	M	Lands NE of Gila Bend north of I-8	1,2,3,4,5,8	11,886	4,073	6,445	1,368	0
	GB3	M	Lands NW of Gila Bend, primarily agricultural lands	1,2,3,5,7,8,9	11,393	1,265	1,746	8,159	224
	GB4	M	Lands in western municipal boundary of Gila Bend and north and south of I-8	1,2,3,5,7,8,9	30,441	8,895	2,424	18,938	184
	GB5	M	Lands north of Gila Bend along SR 85 corridor	1,2,3,5,7,8,9	17,508	6,245	3,601	7,662	0
Glendale	GD1	L	Lands on western municipality boundary	1,2,3,7,9	25,797	2,253	196	23,349	0
	GD2	L	Lands in eastern municipality, including SR 60 and SR 303 corridors	1,2,3,7,9	16,924	0	60	16,864	0
	GD3	L	Lands north of city center, north along the municipal boundary to SR 101	1,2,3,7,9	19,027	10	952	18,064	0
Gilbert	GIL1	L	Municipality of Gilbert	1,2,3,7,9	48,432	2	61	48,369	0

Continued

Table 3.2. Identified treatment management units

Treatment management unit	Map ID	Risk value	Location and description	Recommended treatment[a]	Total acres	Federal acres	State Trust acres	Nonfederal acres	Tribal acres
Gila River Indian Community	GRIC1	M	Tribal lands adjacent to Gila River, NW of St. Johns	1,2,3,5,6,7,8,9	26,135	0	40	854	25,251
	GRIC2	M	Tribal lands west of St. Johns on east-facing slopes of Estrella Mts.	1,2,3,5,6,7,8,9	24,827	11,962	3,241	674	8,950
	GRIC3	H	Community of St. Johns and surrounding Gila River riparian corridor	1,2,3,5,6,7,8,9	13,596	0	14	102	13,480
	GRIC4	M	Lands SW of St. Johns, along Gila River to Pinal County east to I-10 corridor	1,2,3,5,6,7,8,9	37,211	626	3	518	36,064
	GRIC5	M	Lands north of Beltline Road to north boundary of GRIC	1,2,3,5,6,7,8,9	17,712	0	0	0	17,752
	GRIC6	H	Lands along SR 347 east and west of I-10 corridor to the tribal boundary	1,2,3,5,6,7,8,9	18,426	0	0	0	18,426
	GRIC7	M	Lands east of I-10 corridor south of Maricopa County along Gila River riparian corridor	1,2,3,5,6,7,8,9	40,947	234	0	1,057	39,656
Guadalupe	GU1	L	Municipality of Guadalupe	1,2,3	699	0	0	699	0
Goodyear	GY1	L	Lands at the north municipal boundary north of I-10 corridor	1,2,3	12,223	0	1,572	10,651	0
	GY2	L	Community of Goodyear south of I-10 corridor	1,2,3	13,824	0	101	13,723	0
	GY3	M	Lands south of the city of Goodyear along west boundary of Estrella Mt. Regional Park, including the Gila River	1,2,3, 4,7,9	15,674	530	734	14,410	0

Continued

Table 3.2. Identified treatment management units

Treatment management unit	Map ID	Risk value	Location and description	Recommended treatment[a]	Total acres	Federal acres	State Trust acres	Nonfederal acres	Tribal acres
	GY4	M	Lands south of the city of Goodyear, including portions of Estrella Mt. Regional Park and Gila River	1,2,3, 4,7,9	14,453	137	8,765	5,552	0
	GY5	M	Lands south of Estrella Mt. Regional Park to the municipal boundary, including the community of Mobile and SR 238	1,2,3, 4,7,9	105,808	52,477	12,703	40,362	266
Harquahala Valley	H1	M	Lands on eastern boundary of WUI along I-10 corridor	1,2,3,4,5,8	61,838	21,038	18,033	22,767	0
	H2	M	Lands south of I-10 corridor, including Harquahala Valley and Centennial Wash	1,2,3,4,5,8	63,240	8,735	7,045	47,460	0
Litchfield Park	LP1	L	Municipality of Litchfield Park	1,2,3	2,183	0	0	2,183	0
Management Area 1	MA1	M	Open lands in NW portion of WUI	1,2,3,4,5,8	36,177	8,717	1,823	25,638	0
Management Area 2	MA2	M	Lands north of I-10 corridor, west of Buckeye city limits	1,2,3,4,5,8	72,563	7,956	6,150	58,457	0
Management Area 3	MA3	M	Lands to east, primarily south of Harquahala Valley and east of Tonopah	1,2,3,4,5,8	53,536	20,605	8,442	24,489	0
Management Area 4	MA4	M	Buckeye Hills Regional Park and surrounding lands west of SR 85	1,2,3,4,5,8	27,753	19,437	6,483	727	0
Management Area 5	MA5	M	Lands south of Buckeye/Arlington Valley along Gila corridor to north of Gila Bend	1,2,3,4,5,8	29,581	14,052	1,167	14,362	0
Management Area 6	MA6	M	Developed lands west of Gila Bend municipal boundaries along I-8 corridor	1,2,3,4,5,8	89,003	26,752	6,808	55,444	0

Continued

Table 3.2. Identified treatment management units

Treatment management unit	Map ID	Risk value	Location and description	Recommended treatment[a]	Total acres	Federal acres	State Trust acres	Nonfederal acres	Tribal acres
Management Area 7	MA7	M	Lands adjacent to Santa Cruz River, south of Gila/ Santa Cruz River confluence	1,2,3,4,5,7,8,9	23,456	11,524	3,086	8,846	0
Management Area 8	MA8	M	Lands north of I-8 along Santa Cruz River corridor to south of SR 238	1,2,3,4,5,7,8,9	58,727	38,271	1,480	18,976	0
Management Area 9	MA9	L	Lands north of I-8, west of the Santa Cruz River, north to the GRIC boundary	1,2,3,4,5,8	46,440	42,415	2,052	1,970	3
Management Area 10	MA10	M	White Tank Mt. Regional Park	1,2,3,4,5,8	44,898	0	40,826	4,026	0
Management Area 11	MA11	M	McDowell Mt. Regional Park	1,2,3,4,5,8	39,953	5,945	20,892	13,095	21
Management Area 12	MA12	L	Lands at SE WUI boundary, including portions of San Tan Mt. Regional Park	1,2,3,4,5,8	22,940	6,617	729	15,579	16
Mesa	ME1	L	City of Mesa south of SR 202/SR 87 to SR 60	1,2,3,4	49,838	126	949	48,252	511
	ME2	M	Lands east of Mesa south of SR 87, including SR 202 corridor	1,2,3,4,5,8	38,318	6,708	4,417	26,945	247
	ME3	M	Lands SE of Mesa north of Queen Creek, including SR 202 corridor	1,2,3,4,5,8	32,165	0	5,239	26,627	0
New River	NR1	L	Lands east of I-17 corridor, adjacent to Cave Creek Recreation Area, north to TNF boundary	1,2,3,4,5,8	41,375	8,739	24,253	8,383	0
	NR2	M	Lands immediately west of I-17, north of the community to New River to the WUI boundary	1,2,3,4,5,8	6,283	2,532	3,521	229	0
	NR3	M	Lands south of the community of New River to north of SR 74	1,2,3,4,5,8	8,859	172	1,937	6,750	0

Continued

Table 3.2. Identified treatment management units

Treatment management unit	Map ID	Risk value	Location and description	Recommended treatment[a]	Total acres	Federal acres	State Trust acres	Nonfederal acres	Tribal acres
	NR4	M	Lands north of New River, west of I-17 at Yavapai County boundary	1,2,3,4,5,8	6,158	5,173	78	907	0
	NR5	L	Lands NE of New River, west of I-17	1,2,3,4,5,8	19,512	10,074	5,232	4,206	0
Peoria	PE1	L	Lands north and south of SR 74, northwest of the community of Peoria	1,2,3,4,5,8	31,071	3,366	14,376	13,329	0
	PE2	L	Lands north and south of SR 74, north of the community of Peoria	1,2,3,4,5,8	68,295	23,123	19,382	25,790	0
	PE3	M	Lands north and south of SR 74, east of PE2, north of the community of Peoria	1,2,3,4,5,8	23,794	1,314	11,699	10,780	0
	PE4	M	Lands north and south of SR 74, south of PE3, north of the community of Peoria	1,2,3,4,5,8	11,882	180	844	10,859	0
	PE5	L	City of Peoria	1,2,3	22,323	2	588	21,733	0
Phoenix	PHX1	L	North of I-10/I-17 junction, east of Tolleson, west of I-17 north to the community of New River	1,2,3,4,5,8	91,637	2,419	34,608	54,610	0
	PHX2	M	South of Tolleson to South Mt. Regional Park, including Gila River	1,2,3,4,5,6,7,9	68,295	23,123	19,382	25,790	0
	PHX3	M	South Mt. Regional Park north of I-10 corridor	1,2,3,4,7,9	60,070	10	12,144	47,915	0
	PHX4	L	North and west of I-17 corridor to north of Cave Creek Road	1,2,3,4,7,9	158,978	819	33,766	124,393	0
Paradise Valley	PV1	L	Municipality of Paradise Valley	1,2,3	10,579	0	0	10,579	0
Queen Creek	QC1	M	Municipality of Queen Creek	1,2,3,5,8	25,457	0	1,547	23,910	0

Continued

Table 3.2. Identified treatment management units

Treatment management unit	Map ID	Risk value	Location and description	Recommended treatment[a]	Total acres	Federal acres	State Trust acres	Nonfederal acres	Tribal acres
Rio Verde	RV1	M	Lands north and east on Fort McDowell Indian Community	1,2,3,4,5,6,7,9	10,413	9,098	0	1,301	14
	RV2	L	Lands east of Fort McDowell Indian Community, east of Verde River, north of SR 87	SR 87 corridor to vicinity of Four Peaks Road	5,802	1,552	0	4,205	44
	RV3	M	SR 87 corridor, NE of Verde River	1,2,3,4,5,6,7,9	9,979	8,462	0	1,506	11
	RV4	M	SR 87 corridor to vicinity of Four Peaks Road	3,4,5,8	7,709	7,709	0	0	0
Scottsdale	S1	M	Lands east of Carefree to the TNF boundary to the north and east WUI boundary	1,2,3,5,8	42,332	9,269	13,136	19,926	0
	S2	M	Lands north of Salt River Pima-Maricopa Indian Community and SR 101 corridor	1,2,3,5,8	41,252	0	3,410	37,843	0
	S3	M	Lands adjacent to west boundary of McDowell Mt. Regional Park and Fountain Hills	1,2,3,5,8	21,467	0	4,603	16,864	0
	S4	L	City of Scottsdale	1,2,3	21,607	62	538	20,144	863
Sun City	SC1	L	City of Sun City	1,2,3	9,100	0	0	9,100	0
Sun City West	SCW1	L	City of Sun City West	1,2,3	17,517	378	3,793	13,346	
Sunflower	SF1	M	SR 89 corridor north of Four Peaks Road	2,3,4,5,8	6,901	6,871	0	30	0
	SF2	M	SR 89 corridor immediately south of Sunflower	2,3,4,5,8	6,633,	6,408	0	225	0
	SF3	M	Community of Sunflower	2,3,4,5,8	6,954	6,779	0	175	0
	SF4	H	Sunflower along Sycamore Creek	3,4,5,6,7,8,9,	1,320	1,320	0	0	0
	SF5	M	Lands NE of Sunflower, east of SR 87	2,3,4,5,8	5,079	4,868	0	211	0

Continued

Table 3.2. Identified treatment management units

Treatment management unit	Map ID	Risk value	Location and description	Recommended treatment[a]	Total acres	Federal acres	State Trust acres	Nonfederal acres	Tribal acres
Sun Lakes	SL1	L	Community of Sun Lakes	1,2,3	3,864	0	0	3,859	4
Salt River Pima-Maricopa Indian Community	SRPMIC1	M	East of Scottsdale boundary along Gila River	1,2,3,7,9	11,884	0	6	467	11,411
	SRPMIC2	L	East of Scottsdale boundary, north of Gila River	1,2,3	7,592	0	0	0	7,592
	SRPMIC3	M	East of Scottsdale boundary, north to the north SRPMIC boundary	1,2,3	7,165	0	0	104	7,061
	SRPMIC4	M	Northern SRPMIC boundary	1,2,3	10,716	0	0	244	10,472
	SRPMIC5	M	SRPMIC southern boundary, east along Gila River to east boundary and adjacent lands	1,2,3,7,9	20,200	3,326	0	1,443	15,431
Surprise	SU1	M	NE of the city of Surprise along the US 60 corridor, including Trilby Wash Basin	1,2,3,5,7,8,9	32,117	254	11,558	20,306	0
	SU2	M	Lands NE of the city of Surprise along US 60 corridor	1,2,3,5,8	20,455	0	3,476	16,978	0
	SU3	L	City of Surprise	1,2,3	24,964	0	97	24,867	0
Tempe	T1	L	Municipality of Tempe	1,2,3	23,898	84	555	23260	57
Tonto Hills	TH1	L	Tonto Hills subdivision	1,2,3	480	39	0	442	0
Tonopah Valley	TO1	M	Lands south of I-10, east of community of Tonopah, adjacent to Palo Verde Nuclear Generating Station	1,2,3,4,5,8	49,982	6,863	8,225	34,894	0
	TO2	M	Tonopah Valley, including community of Tonopah south of I-10 corridor	1,2,3,4,5,8	47,235	22,824	7,281	17,130	

Continued

Table 3.2. Identified treatment management units

Treatment management unit	Map ID	Risk value	Location and description	Recommended treatment[a]	Total acres	Federal acres	State Trust acres	Nonfederal acres	Tribal acres
Tolleson	TOL1	M	Community of Tolleson	1,2,3	3,967	0	3	3,964	0
Wickenburg	WB1	L	City of Wickenburg, Hassayampa River, and lands immediately west	1,2,3,4,5,7,8,9	26,927	1,078	11,818	14,030	0
	WB2	M	City of Wickenburg and lands immediately west	1,2,3,4,5,8	11,457	1,491	4,686	5,280	0
Wittmann	WT1	M	Lands surrounding the community of Wittmann	1,2,3,4,5,8	16,044	0	3,375	12,669	0
Youngtown	YT1	L	City of Youngtown	1,2,3	1,503	0	24	1,479	0

Note: L = low, M = moderate, H = high.

[a]See Table 3.1 for recommended treatments.

[b]Apache Junction is included in the 2009 Pinal County CWPP.

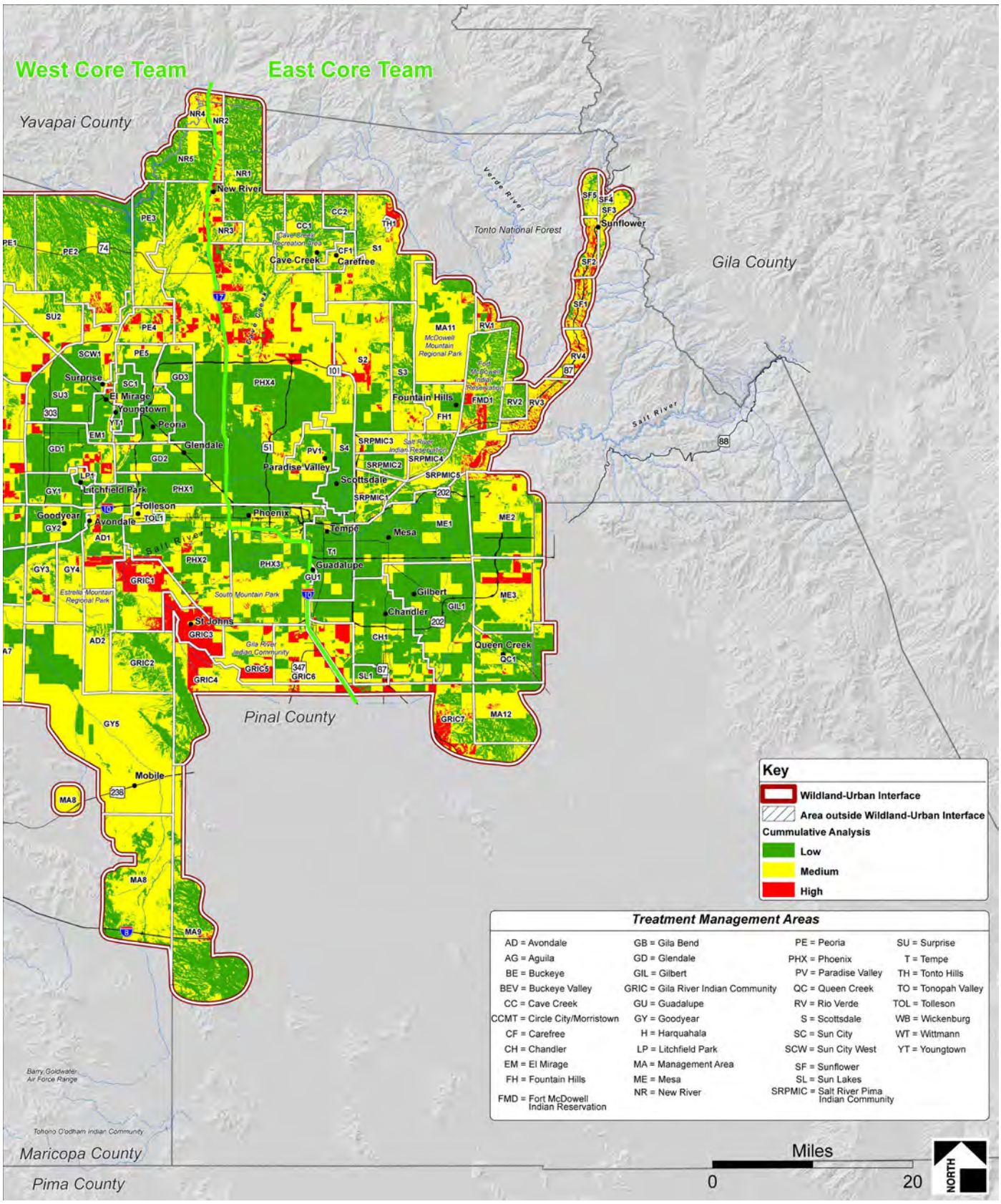

Figure 3.1a. Maricopa County CWPP treatment management units, east

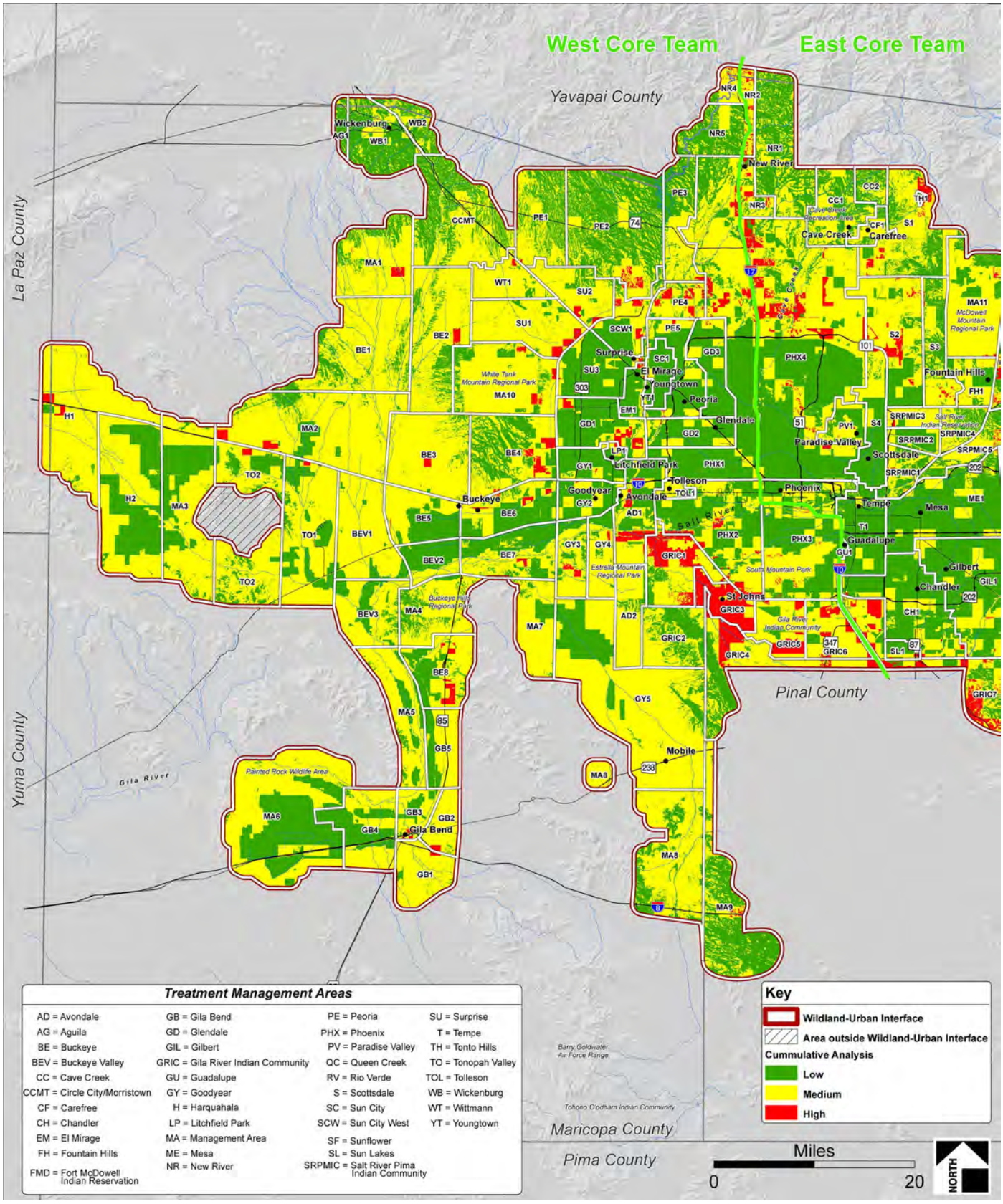

Figure 3.1b. Maricopa County CWPP treatment management units, west

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 alternative 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. Recent costs of fuels mitigation treatment on BLM lands within the WUI include $100.00/acre for mowing, $500.00/acre for mastication and 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 $500.00 to $1,000.00/acre on small land parcels consisting mostly of treatments within riparian corridor treatments 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; San Juan County Watershed Group 2005; Ken Shaver, BLM, pers. comm. 2009).

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 Maricopa County CWPP WUI.

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 nonfederal 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. Vegetative fuel mitigation costs for this CWPP are estimated to be $350.00/acre, which is comparable to the estimated cost of the ASLD Forestry Division Fire and Fuels Crews and to estimated fuel-mitigation costs on adjacent federal lands.

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 have the plan prepared or certified by a professional forester, by a certified arborist, by other qualified individuals, or in conjunction with local fire department or fire districts recommendations that reference Firewise guidelines. 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 feet 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.

The recommended treatments within the Maricopa County CWPP have been developed consistent with federal land-management action alternatives and are intended to be compliant with and facilitate efficient planning and decision making concerning fuels mitigation treatments or habitat rehabilitation 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 Maricopa County CWPP will be used as a resource to help coordinate long-term interagency mitigation of catastrophic wildfire events in at-risk communities within Maricopa County. The Maricopa County CWPP Core Teams established specific goals for wildland fire prevention and loss mitigation as follows:

- Improve fire prevention and suppression for firefighter and public safety and to protect private property
- Promote community collaboration, involvement, and education
- Recommend measures to reduce structural ignitability in the Maricopa 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 Maricopa County CWPP will be reviewed and updated as needed. Successful implementation of this plan will require a collaborative process among multiple layers of government entities and a broad range of community interests. The MCDEM 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-way 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-way. APS has already undertaken a vegetative management program with its main power transmission lines that run northwest from Pima and Dynamite Road to the TNF. The Core Teams recognize existing agreements between SRP, APS, land-management agencies, and private

landowners for vegetative treatments within rights-of-way and easements, and agree that the Maricopa County CWPP does not bind or obligate SRP and APS in maintenance of vegetative fuels outside their rights-of-way or easements. The Core Teams believe that these agreements and resultant vegetative treatments are complementary to the objectives of the Maricopa County CWPP. Therefore, at the request of the MCDEM and the Core Teams, APS and SRP have agreed to be included as signatories to the Maricopa 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 Maricopa County CWPP:

1. Maricopa County CWPP Administration and Implementation

- Establish a countywide community Maricopa County CWPP Working Group—composed of Maricopa County fire chiefs, MCDEM, ASFD, BLM, TNF, 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 Maricopa County CWPP WUI, including fuel hazards removal on private lands within the WUI.

2. Improved Protection Capability and Reduction in Structural Ignitability

The Maricopa 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 Maricopa 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 use by fire departments and districts; 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.
- Encourage fire departments and districts to participate in annual multi-agency wildland fire safety training conducted prior to the fire season.
- 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 mini water tending, 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-way 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-way.
- 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 Maricopa County where they have not been adopted.
- Develop IGAs with Maricopa 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

Maricopa 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 Maricopa 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, and the development of specific promotional materials by Maricopa 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 Maricopa 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 within highest risk communities.
- 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. Maricopa 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 visitors 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. MARICOPA 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 Maricopa 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 Maricopa County CWPP objectives. For the life of the Maricopa 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 Maricopa County CWPP. Establishing a unified effort to collaboratively implement the Maricopa 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 CWPP Working Group (CWPP Working Group)—composed of the fire chiefs from Maricopa County or their representatives, ASFD, MCDEM, TNF, and BLM—to work with the Core Teams and concurring agencies to accomplish the recommendations for outreach and structural ignitability within the Maricopa County CWPP WUI area, which include fuel hazards removal on private lands within the WUI. The CWPP Working Group should consist of community members; local fire departments and districts; and, as needed, additional representatives from the MCDEM, ASFD, ASLD, TNF, BLM, and other concurring agencies. MCDEM will be the lead agency responsible for coordinating the CWPP Working Group and producing the monitoring reports and future updating of the CWPP.

The CWPP Working Group will prioritize wildland fuel modification, structural ignitability, protection capability, and public outreach projects listed in the approved Maricopa County CWPP on a countywide basis, and will review these priority recommendations for possible reprioritization at least once annually subsequent to approval of the Maricopa County CWPP by ASFD. Fuel modification and community planning, outreach, and warning programs will be prioritized by the CWPP Working Group as a whole; other projects involving firefighter training, equipment, communications, facilities, and apparatus will be recommended by the fire chiefs from Maricopa County or their representatives in the CWPP Working Group.

The CWPP Working Group is expected to be an advocate for and provide support to 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 CWPP Working Group. Additionally, individual agencies will be able to seek letters of support from the CWPP Working Group or partner agencies in applying for funding for projects identified as priorities by the Working Group.

The CWPP Working Group will also compile annual monitoring and reporting from cooperating agencies to provide information on additional measures necessary to meet Maricopa County CWPP goals, including additional future recommendations from fire departments and districts and other agencies for inclusion in the priorities list. The CWPP Working Group may also act as an advisory group to Maricopa 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.

The following general criteria will be used for prioritizing proposed projects and action items:

1. Geographic/fuel-load/residential density:
    a. The New River, Sunflower, St. Johns, and Gila River riparian corridor from St. Johns through the Gila Bend Valley sub-WUIs will receive long-term priority due to high vegetative fuel risk, ignition history, and threatened structures and infrastructures.
    b. In any given year, the 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.
    c. In any given year, the 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.
2. Categorical/functional criteria—priorities will generally be established in the order listed below; these priorities are subject to review and change by the Maricopa County CWPP Working Group on an ongoing basis:
    a. Fuel modification projects (first priorities will be for those projects within fire-department and fire-district, TNF, BLM, or ASFD jurisdictions within the New River, Sunflower, St. Johns, and Gila River riparian corridor sub-WUIs)
    b. Enhanced wildland firefighter training and acquisition of personal protection equipment (PPE)
    c. Wildland-fire suppression equipment and tools, including brush engines and tenders
    d. Water-storage sites and supply facilities
    e. Community planning and outreach activities, including warning signs/systems and identification and improvement of evacuation routes
    f. Radios for primary use by trained and designated wildland fire crews
    g. Helicopter pads for firefighter deployment or evacuation
    h. Fire stations in areas with sufficiently high threat and population densities as determined annually by the CWPP Working Group
    i. 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, TNF, ASFD, MCDEM, and fire departments and districts will coordinate fuel mitigation projects on state, public, and forest lands, and also within SRP and APS utility corridors, within the WUI in coordination with the CWPP Working Group when established. The Core Teams and the proposed 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, TNF, ASFD, MCDEM, 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 CWPP Working Group will provide information on additional measures necessary to meet Maricopa 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 CWPP Working Group will meet subsequent to the ASFD's final approval of the Maricopa 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 CWPP Working Group support.

Table 4.1. Action recommendations for wildland fuel modification

Management area[a]	Location and description	Project partner	Estimated treatment cost[b]
SF2	Lands along SR 89 to the south of the community of Sunflower	MCDEM, ASFD, and TNF	2,153 high-risk acres, 30% of lands to be treated over 3 years estimated to be 215 acres/year in FY 2011–14 = $72,250.00/year; cost estimated to average $350.00/acre on federal, ASLD, and private lands
NR3	Lands along the I-10 corridor, south of the community of New River	MCDEM, ASLD, ASFD, and Daisy Mountain Fire District	1,412 high-risk acres, 30% of lands to be treated over 3 years estimated to be 140 acres/year in FY 2011–14 = $49,000.00/year; cost estimated to average $350.00/acre on federal, ASLD, and private lands
GRIC1	Gila River corridor west of St. Johns	MCDEM, Gila River Indian Community, and Bureau of Indian Affairs Pima Agency	8,180 high-risk acres, 30% of lands to be treated (riparian acres) over 3 years estimated to be 90 acres/year in FY 2011–14 = $315,00.00/year; cost estimated to average $350.00/acre on tribal lands
GB2	Gila Bend Valley north of the community of Gila Bend	MCDEM, ASFD, BLM, and Gila Bend Fire District	403 high-risk acres, 30% of lands to be treated (riparian acres) over 3 years estimated to be 40 acres/year in FY 2011–14 = $14,000.00/year; cost estimated to average $350.00/acre on private lands
Firebreak maintenance	1- to 2-year rotating maintenance of fine and light fuels in Firebreaks SF1, NR2, GR4, and GB2	ASLD, ASFD, CNF, TNF, MCDEM, 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] SF = Sunflower; NR = New River; GRIC = Gila River Indian Community; GB = Gila Bend.

[b] 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	Project	Specific recommendation	Estimated cost	Timeline
MCDEM and Queen Creek Fire Department	**E1**—Wildland Fire Protection and Reduced Ignitability	Purchase one Type 3 fire engine for use by Queen Creek Fire Department	New acquisition with standard equipment $280,000.00	Begin grant applications in 2010; purchase in 2011
MCDEM and Sun Lakes Fire District	**E1**—Wildland Fire Protection and Reduced Ignitability	Purchase one Type 6 fire engine for use by Sun Lakes Fire District	New acquisition with standard equipment $131,000.00	Begin grant applications in 2010/2011; purchase in 2011/2012
MCDEM, TNF, CNF, ASFD, ASLD, and associated fire departments and districts	**A1**—Wildland Fire Protection and Reduced Ignitability	Construct a series of 5,000-gal water-storage facilities located strategically throughout residential areas	Install water-storage facilities/year: $5,000.00/facility	Locate and install one water-storage facility in 2010
MCDEM and Gilbert Fire Department	**A2**—Enhanced Public Education, Information, and Outreach	Wildfire Public Education Brochures	Produce and publish community specific wildfire informational brochures	Begin grant applications in 2010; continue on an ongoing basis in 2011
MCDEM and Rural/Metro, Cave Creek, and Carefree Fire Departments	**E2**—Wildland Fire Protection and Reduced Ignitability	Obtain one Type 6 brush truck for wildland fire response within the Cave Creek and Carefree communities	New acquisition with standard equipment $131,000.00	Begin grant applications in 2010; purchase in 2011
MCDEM, TNF, CNF, ASFD, ASLD, and associated fire departments and districts	**E3**—Wildland Fire Protection and Reduced Ignitability	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
	A2—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

Continued

Table 4.2. Action recommendations for structural ignitability and public outreach

Project partner	Project	Specific recommendation	Estimated cost	Timeline
MCDEM, TNF, CNF, ASFD, ASLD, and associated fire departments and districts	**A3**—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 2010; conduct in 2010
		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 2010; publish and post in 2010
MCDEM and Glendale Fire Department	**E4**—Wildland Fire Protection and Reduced Ignitability	Obtain one Type 6 brush truck and a water tender for wildland fire response within Glendale	New acquisition with standard equipment $131,000.00; 1,500-gal water tender, 4-wheel drive: $186,000	Begin grant applications in 2010; purchase in 2011
MCDEM and Sun City West Fire District	**E5**—Wildland Fire Protection and Reduced Ignitability	Obtain one Type 3 engine and a water tender for wildland fire response within the Sun City West Fire District	New acquisition with standard equipment $170,000.00; 2,000-gal water tender, 4-wheel drive: $300,000.00: 1500 gal Type 3 Engine	Begin grant applications in 2010; purchase in 2011

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

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

Project partner	Project[a]	Equipment/expense	Timeline
MCDEM, ASFD, FS, and associated fire departments and districts	**E5**—Obtain a medium-size water tender to better traverse rural landscape than larger units	1,500-gal water tenders, 4-wheel drive: $185,000.00	Acquire tender in FY 2010/11; assess additional tender needs in FY 2010/11
MCDEM, 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
MCDEM, ASFD, CNF, TNF, BLM, and associated fire departments and districts	**A4**—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
MCDEM, ASFD, CNF, TNF, BLM, and associated fire departments and districts	**A5**—Work with Maricopa 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
MCDEM, ASFD, CNF, TNF, BLM, APS, SRP, and associated fire departments and districts	**A6**—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

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

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

The MCDEM 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 communities.

Table 4.4 displays the Maricopa 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, TNF, 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, TNF, and BLM.

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

Project partner	Project[a]	Equipment/expense	Timeline
MCDEM, CNF, TNF, BLM, ASFD, and associated fire departments and districts	**A7**—Establish and maintain roadside fire-danger warning signs and other informational and directional road signs along major roads as determined by the Maricopa County Fire Officers Association	Construction and placement: $5,000.00	Construct and implement in FY 2010/11
	A8—Create and distribute community bulletins	Development, printing, and distribution costs: $5,000.00	Develop in FY 2010; distribute continually
	I2—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 Assessment completion: $2,000.00	Acquire software and complete assessments in FY 2010/11; implement recommendations in FY 2011
	I3—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
	I4—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

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

V. MONITORING PLAN

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

In accordance with Section 102.g.5 of HFRA, Maricopa 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 Maricopa County CWPP objectives. This authority to participate in multiparty monitoring will be vested in the CWPP Working Group. 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, TNF, ASFD, ASLD, MCDEM, local municipalities, and fire departments and districts with land-management planning.

The CWPP Working Group 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 Maricopa 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 Maricopa County CWPP action recommendations. Monitoring will include assessing and evaluating the success of individual Maricopa County CWPP project implementation and a given project's effectiveness in furthering Maricopa County CWPP objectives.

A. Administrative Oversight, Monitoring, and Maricopa County CWPP Reporting

The CWPP Working Group, composed of Maricopa County fire chiefs, MCDEM, TNF, ASFD, and BLM, will be mutually responsible for implementing and monitoring Maricopa County CWPP action recommendations in coordination with a future established CWPP Working Group. The CWPP Working Group should identify appropriate grant and other funding mechanisms necessary to implement the action recommendations of the Maricopa 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 MCDEM, in coordination with the future-established countywide community CWPP Working Group, will produce a report detailing the success of Maricopa County CWPP project implementation and overall progress toward meeting Maricopa County CWPP goals. The CWPP Working Group should report successful grant awards received for implementing the Maricopa County CWPP action recommendations to the Maricopa County CWPP signatories. The CWPP Working Groups' report will also include recommendations to the signatories for updating the Community Mitigation Plan and the Prevention and Loss Mitigation Plan portions of the Maricopa 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 Maricopa County CWPP. Appendix D provides information on the data used in the analysis of the Maricopa County CWPP and the appropriate contacts for updating the Maricopa County CWPP. Once the Maricopa County CWPP is updated, it will be submitted to the MCDEM, the Arizona State Forester, all cooperating fire departments and districts, municipal governments, TNF, and BLM for their concurrence. Once concurrence is achieved, the action recommendations of the updated Maricopa 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 CWPP Working Group will use to assess Maricopa County CWPP performance against goals for the fiscal year. In addition to monitoring the listed performance measures, Maricopa County CWPP administrators should assess the current status of wildland fuel hazards and look for any new or developing issues not covered by the Maricopa County CWPP. As new issues arise, such as new invasive-species infestations, further risks and recommendations for treatment should be identified, and the Maricopa County CWPP should be updated or amended as necessary to meet the Maricopa County CWPP goals. To help track fuel treatments being planned and completed through local, state, and federal programs, the Maricopa 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 Maricopa County CWPP progress

Goal	Performance measure
Improve fire prevention and suppression	Reduction of wildland fire occurrence and acres burned (unplanned) in the WUI: • Green-waste disposal sites available in high-risk communities. • Type 3 fire engine acquired by Queen Creek Fire Department. • Type 6 brush truck acquired for use in Carefree and Cave Creek sub-WUIs. • Type 6 brush truck acquired for use in Sun Lakes sub-WUI. • Effectiveness monitoring of fire prevention and suppression will include the following: — Acres burned and degree of severity of wildland fire — Percentage of wildland fire controlled on initial attack — Number of homes and structures lost to wildland fire • New water sources developed in key areas. • Consistent fire training in use. • Wildland firefighter PPE (personal protection equipment) acquired as needed.
Reduce hazardous vegetative fuels	Effective treatment of high-risk areas by acre: • Number of treated acres of nonfederal WUI lands that are in Condition Class 2 or 3 are identified as high priorities by the Maricopa County CWPP and should be moved to Condition Class 1 or another acceptable level of wildland fuel loading and continuity. • Acres treated to acceptable fuel levels within priority treatment management areas. • Total acres treated through any fuel-reduction measures, including prescribed fire, 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: • Coordination with and support of MCDEM, ASFD, ASLD, TNF, 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). • Acres of saltcedar-invaded riparian areas identified and undergoing restoration treatments.
Promote community involvement	Initiation of public outreach programs: • Countywide community CWPP Working Group initiated. • Public outreach programs and promotions implemented to enhance volunteer efforts to reduce hazardous fuels. • Number and areas (community or dispersed residents) of private landowners supporting and implementing fuel reduction projects. • MCDEM and local fire departments and districts developed and implemented evacuation plans for identified high-risk areas. • Roadside fire-danger warning signs in English and Spanish installed at strategic points within the WUI. • Green-waste disposal and processing site secured and operational. • Fire-awareness articles printed in local newspapers. • 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: • Number of value-added wood products developed by the community. • 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 Maricopa County Community Wildfire Protection Plan have reviewed and do mutually agree or concur with its contents:

Agreement

Maricopa County Board of Supervisors	Date
City of Aguila	Date
City of Apache Junction	Date
City of Avondale	Date
City of Buckeye	Date
Town of Carefree	Date
City of Cave Creek	Date
City of Chandler	Date
Town of Circle City-Morristown	Date
Town of El Mirage	Date
Town of Fountain Hills	Date
Town of Gila Bend	Date

Town of Gilbert	Date
City of Glendale	Date
City of Goodyear	Date
Town of Guadalupe	Date
City of Litchfield Park	Date
City of Mesa	Date
City of Paradise Valley	Date
City of Peoria	Date
City of Phoenix	Date
Town of Queen Creek	Date
City of Tempe	Date
City of Tolleson	Date
City of Scottsdale	Date
City of Surprise	Date

Town of Wickenburg	Date
Town of Wittmann	Date
Town of Youngtown	Date
Arizona Public Service Company	Date
National Oceanic and Atmospheric Administration, NWS, Phoenix	Date
Salt River Project	Date
Chief, Aguila Fire District	Date
Chief, Apache Junction Fire Department	Date
Chief, Avondale Fire Department	Date
Chief, Buckeye Fire Department	Date
Chief, Buckeye Valley Rural Fire District	Date
Chief, Carefree Fire Department	Date
Chief, Cave Creek Fire Department	Date
Chief, Chandler Fire Department	Date

Chief, Circle City/Morristown Volunteer Fire Department	Date
Chief, Daisy Mountain Fire District	Date
Chief, El Mirage Fire Department	Date
Chief, Fountain Hills Rural Metro Fire Department	Date
Chief, Gilbert Fire Department	Date
Chief, Glendale Fire Department	Date
Chief, Goodyear Fire Department	Date
Chief, Guadalupe Fire Department	Date
Chief, Fountain Hills Fire Department	Date
Chief, Gila Bend Volunteer Fire Department	Date
Chief, Mesa Fire Department	Date
Chief, Paradise Valley Fire Department	Date
Chief, Peoria Fire Department	Date
Chief, Phoenix Fire Department	Date

Chief, Queen Creek Fire Department	Date
Chief, Scottsdale Fire Department	Date
Chief, Sun City Fire District	Date
Chief, Sun City West Fire District	Date
Chief, Sun Lakes Fire District	Date
Chief, Surprise Fire Department	Date
Chief, Rio Verde Fire District	Date
Chief, Tolleson Fire Department	Date
Chief, Tempe Fire Department	Date
Chief, Wickenburg Fire Department	Date
Chief, Wittmann Fire District	Date

Concurrence

Arizona State Forester Arizona State Forestry Division	Date
Phoenix District Manager Bureau of Land Management	Date
Cave Creek District Ranger Tonto National Forest	Date
Emergency Manager Salt River Pima-Maricopa Indian Community	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. 2009. 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. 2007. *Identifying Arizona's Wildland/Urban Interface Communities at Risk: A Guide for State and Federal Land Managers*.

Arizona State Forester. 2009. *Arizona-Identified Communities at Risk.* http://www.azstatefire.org.

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

Burgan, R. 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.

Central Arizona Wildland Response Team. 2007. *Strategic Plan 2007-2012*.

City of Scottsdale Fire Department. 2010. *McDowell Sonoran Preserve Fire and Emergency Response Plan*.

Cohen, J. 2008. *The Wildland Urban Interface Fire Problem A Consequence of the Fire Exclusion Paradigm.* Forest History Today. Forest History Society. 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. *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.

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

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.

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

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

Maricopa County Department of Emergency Management (MCDEM) and JE Fuller / Hydrology and Geomorphology. 2009. *Maricopa County Multi-Jurisdictional Hazard Mitigation Plan*.

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*.

NRCS. 2010. *MLRA Explorer Custom Report. D-Western Range and Irrigated Region 40-Sonoran Basin and Range.* USDA Agriculture Handbook 296. http://soils.usda.giv/MLRAExplorer (accessed January 2010).

NRCS. 2010. *MLRA Explorer Custom Report. D-Western Range and Irrigated Region 38-Mogollon Transition.* USDA Agriculture Handbook 296 http://soils.usda.giv/MLRAExplorer (accessed January 2010).

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

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.

Southwest Strategy. 2009. S*outhwest Community Wildfire Protection Plan Guide*. Southwest Strategy Wildland Urban Interface Task Team. http://azsf.az.gov/UserFiles/PDF/wildfire_plan_guide.pdf (accessed October 2009).

US Census Bureau. 2008. Maricopa 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. 2005. *Tonto National Forest Land and Resource Management Plan.* Tonto National Forest, Mesa.

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 FS and USDI BLM. 2009. *Guidance for Implementation of Federal Wildland Fire Management Policy.* Fire Executive Council. February 13, 2009

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)

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 District: A special taxing district organized for community fire protection under Arizona Revised Statutes Chapter 5 Fire Districts, Article 1 General Provisions, 48-805.

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.

Participating Agency: 1) an agency that has an interest in, is consulted about, and has the opportunity to become involved in a project or program; or 2) an agency invited to be included in the production, review, development of plans or process for a project without authority to act or does not intent to act with respect to the project

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 was adapted from the *Southwest Regional GAP Analysis Project—Land Cover Data Legend Descriptions* (USGS 2005) and was used to analyze vegetation associations composing the WUI of the Maricopa 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 shrubs 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,* and *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 thorn scrub 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 porter,* and *Pleuraphis mutica* may be common but generally have lower cover than shrubs.

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 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 are 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 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 that 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 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 ASSOCIATIONS

S057 Mogollon Chaparral

Concept Summary: This ecological system occurs across central Arizona (Mogollon Rim), western New Mexico, southwestern Utah, and southeast Nevada. It often dominates 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 drier 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 fire adapted, 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 into Trans-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, sometimes, desert scrub. 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 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;* these species are 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 drier chaparral systems, stands of chaparral are not dominated by Madrean oaks, however Madrean encinal may extend down along drainages.

S112 Madrean Pinyon-Juniper Woodland

Concept Summary: This system occurs on foothills, mountains, and plateaus in the Sierra Madre Occidentale and Sierra Madre Orientale in Mexico, in Trans-Pecos Texas, in southern New Mexico, and in southern and central Arizona from the Mogollon Rim south to the Sky Islands. Substrates are variable, but soils are generally dry and rocky. The presence of *Pinus cembroides, Pinus discolor*, or other Madrean trees and shrubs is diagnostic of this woodland system. *Juniperus coahuilensis, Juniperus deppeana, Juniperus pinchotii, Juniperus monosperma*, and/or *Pinus edulis* may be present to dominant. Madrean oaks such as *Quercus arizonica, Quercus emoryi*, *Quercus grisea,* or Quercus mohriana may be codominant. *Pinus ponderosa* is absent or sparse. If present, understory layers are variable and may be dominated by shrubs or graminoids

S115 Madrean Juniper Savanna

Concept Summary: This Madrean ecological system occurs in lower foothills and plains of southeastern Arizona, southern New Mexico, and extending into west Texas and Mexico. These savannas have widely spaced mature juniper trees and moderate to high cover of graminoids (>25% cover). The presence of *Madrean Juniperus* spp. such as *Juniperus coahuilensis, Juniperus pinchotii*, and/or *Juniperus deppeana* is diagnostic. *Juniperus monosperma* may be present in some stands, and *Juniperus deppeana* has a range that extends beyond this Madrean system into southern stands of the Southern Rocky Mountain Juniper Woodland and Savanna (CES306.834). Stands of *Juniperus pinchotii* may be short and resemble a shrubland. Graminoid species are a mix of those found in the Western Great Plains Shortgrass Prairie

(CES303.672) and the Apachierian-Chihuahuan Piedmont Semi-Desert Grassland and Steppe (CES302.735), with *Bouteloua gracilis* and *Pleuraphis jamesii* being most common. In addition, these areas include succulents such as species of *Yucca, Opuntia*, and *Agave*. Juniper savanna expansion into grasslands has been documented in the last century.

S036 Rocky Mountain Ponderosa Pine Woodland

Concept Summary: This very widespread ecological system is most common throughout the cordillera of the Rocky Mountains. It is also found in the Colorado Plateau region, west into scattered locations in the Great Basin, and north into southern British Columbia. These woodlands occur at the lower treeline/ecotone between grassland or shrubland and more mesic coniferous forests typically in warm, dry, exposed sites. Elevations range from less than (Ecological Systems: Copyright © 2003 NatureServe) 48500 m in British Columbia to 2,800 m in the New Mexico mountains. Occurrences are found on all slopes and aspects; however, moderately steep to very steep slopes or ridgetops are most common. This ecological system generally occurs on igneous-, metamorphic-, and sedimentary-derived soils, with characteristic features of good aeration and drainage, coarse textures, circumneutral to slightly acid pH, an abundance of mineral material, rockiness, and periods of drought during the growing season. These woodlands in the eastern Cascades, Okanagan, and northern Rockies regions receive winter and spring rains, and thus have a greater spring “green-up” than the drier woodlands in the central Rockies. *Pinus ponderosa* is the predominant conifer; *Pseudotsuga menziesii, Pinus edulis*, and *Juniperus* spp. may be present in the tree canopy. The understory is usually shrubby, with *Artemisia nova, Artemisia tridentata, Arctostaphylos patula, Arctostaphylos uva-ursi, Cercocarpus montanus, Cercocarpus ledifolius, Purshia stansburiana, Purshia tridentata, Quercus gambelii, Symphoricarpos oreophilus, Prunus virginiana, Amelanchier alnifolia*, and *Rosa* spp. as common species. *Pseudoroegneria spicata* and species of *Hesperostipa, Achnatherum, Festuca, Muhlenbergia*, and *Bouteloua* are some of the common grasses. Mixed fire regimes and ground fires of variable return interval maintain these woodlands, depending on climate, degree of soil development, and understory density.

EVERGREEN FOREST TYPES

S035 Madrean Pine-Oak Forest and Woodland

Concept Summary: This system occurs on mountains and plateaus in the Sierra Madre Occidentale and Sierra Madre Orientale in Mexico, in Trans-Pecos Texas, in southern New Mexico, and in southern and central Arizona from the the Mogollon Rim southeastward to the Sky Islands. These forests and woodlands are composed of Madrean pines (*Pinus arizonica, Pinus engelmannii, Pinus leiophylla* or *Pinus strobiformis*) and evergreen oaks (*Quercus arizonica, Quercus emoryi,* or *Quercus grisea*) intermingled with patchy shrublands on most mid-elevation slopes (1,500–2,300 m elevation). Other tree species include *Cupressus arizonica, Juniperus deppeana, Pinus cembriodes, Pinus discolor, Pinus ponderosa* (with Madrean pines or oaks), and *Pseudotsuga menziesii*. Subcanopy and shrub layers may include typical encinal and chaparral species such as *Agave* spp., *Arbutus arizonica, Arctostaphylos pringlei, Arctostaphylos pungens, Garrya wrightii, Nolina* spp., *Quercus hypoleucoides, Quercus rugosa*, and

Quercus turbinella. Some stands have moderate cover of perennial graminoids such as *Muhlenbergia emersleyi, Muhlenbergia longiligula, Muhlenbergia virescens*, and *Schizachyrium cirratum*. Fires are frequent with perhaps more crown fires than ponderosa pine woodlands, which tend to have more frequent ground fires on gentle slopes.

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 the 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 depends on annual rise in the water table for growth and reproduction.

S097 North American Warm Desert Riparian Woodland and Shrubland

Concept Summary: This ecological system consists of low-elevation (<1,200 m) riparian corridors along medium to large perennial streams throughout canyons and the desert valleys of the southwestern United States and adjacent Mexico. The vegetation is a mix of riparian woodlands and shrublands. Dominant trees include *Acer negundo, Fraxinus velutina, Populus fremontii, Salix gooddingii, Salix lasiolepis, Celtis laevigata* var. *reticulata*, and *Juglans major*. Shrub dominants include *Salix geyeriana, Shepherdia argentea*, and *Salix exigua*. Vegetation depends on annual or periodic flooding and associated sediment scour and/or annual rise in the water table for growth and reproduction.

D04 Invasive Southwest Riparian Woodland and Shrubland

Description: *Tamarix* spp. Semi-Natural Temporarily Flooded Shrubland Alliance (A842), or *Elaegnus angustifolus* Semi-Natural Woodland Alliance (A3566).

Tamarix spp. Semi-Natural Temporarily Flooded Shrubland Alliance

Translated Name: Saltcedar species Semi-natural Temporarily Flooded Shrubland Alliance
Unique Identifier: A.842
Classification Approach: International Vegetation Classification (IVC)

Concept Summary: This alliance is composed of shrublands that form moderately dense to dense thickets on banks of larger streams, rivers, and playas across the western Great Plains, interior and southwestern United States, and northern Mexico. Stands are dominated by introduced species of *Tamarix*, including *Tamarix ramosissima, Tamarix chinensis, Tamarix gallica*, and *Tamarix parviflora*. Introduced from the Mediterranean, *Tamarix* spp. have become naturalized in various sites, including salt flats, springs, and especially along streams and regulated rivers, often replacing *Salix* or *Prosopis* spp. shrublands or other native vegetation. A remnant herbaceous layer may be present, depending on the age and density of the shrub layer. These species have become a critical nuisance along most large rivers in the semi-arid

western United States. Because of the difficulty to remove, *Tamarix* spp. may have irreversibly changed the vegetation along many rivers.

Classification Comments: This broadly defined alliance is composed of many diverse *Tamarix* spp.-dominated vegetation communities from a wide variety of environments. Common species of *Tamarix* include *Tamarix ramosissima, Tamarix chinensis*, and *Tamarix parviflora*, but other species are reported from the western United States, such as *Tamarix africana, Tamarix aphylla, Tamarix aralensis, Tamarix canariensis, Tamarix gallica*, and *Tamarix tetragyna*.

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

N21 Developed, Open Space–Low Intensity

Concept Summary: *Developed Open Space* includes areas with a mixture of some construction materials but mostly includes 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 ncludes 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 80–100 percent of the total cover (National Land Cover Data) draft legend, July 25, 2003).

N31 Barren Land Types, Non-specific

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.

N80 Agriculture

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

S013 Inter-Mountain Basins Volcanic Rock and Cinderland

Concept Summary: This ecological system occurs in the Intermountain western United States and is limited to barren and sparsely vegetated volcanic substrates (generally <10% plant cover) such as basalt

lava (malpais), basalt dikes with associated colluvium, basalt cliff faces and uplifted “backbones,” tuff, cinder cones, or cinder fields. It may occur as large-patch, small-patch, and linear (dikes) spatial patterns. Vegetation is variable and includes a variety of species depending on local environmental conditions, for example, elevation, age, and type of substrate. At montane and foothill elevations scattered *Pinus ponderosa, Pinus flexilis*, or *Juniperus* spp. trees may be present. Shrubs such as *Ephedra* spp., *Atriplex canescens, Eriogonum corymbosum, Eriogonum ovalifolium*, and *Fallugia paradoxa* are often present on some lava flows and cinder fields. Species typical of sand dunes such as *Andropogon hallii* and *Artemisia filifolia* may be present on cinder substrates.

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. 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 or more inches long (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 predominates

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.

Wildfire Defense Get in the Zone, Reduce Your Risk of Wildfire, pamphlet. The FireFree Program, sponsored by SAFECO Corporation. 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 US 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. This Web site lists 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

US 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) standards: 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, Colorado State Forest Service. Publications to help assist you with wildfire prevention. 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 Web site. http://www.nifc.nps.gov/fire.

"Fire Wars," PBS NOVA. 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, American Planning Association (APA), May 2001. This 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 FEMA. This 38-page booklet details 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, Institute for Business and Home Safety (IBHS), 2001. This IBHS 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 US 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 US Forest Service, Southwestern Region, 12 page document.

Wildfire Strikes Home! (Publication no. NFES 92075); *It Could Happen to You, How to Protect Your Home!* (Publication no. NFES 92074). Homeowners handbooks from the US Bureau of Land Management, the US Forest Service, and state foresters.

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.	Jared Wahlberg (480) 967-1343; jwahlberg@lsdaz.com
Wildland-Urban Interface (WUI)	Shapefile	Logan Simpson Design Inc.	Jared Wahlberg (480) 967-1343; jwahlberg@lsdaz.com
Vegetation Zones	Raster	Southwest Regional Gap Analysis Project (USGS 2005)	http://earth.gis.usu.edu/swgap/
Well Locations	Shapefile	ADWR	ADWR 602-771-8638 mxb@azwater.gov
Land Ownership	Shapefile	Arizona State Land Department	Land Resources Information System Published 20071029 Gary Irish (602) 542-2605
Land Parcel data	Shapefile		(602) 506-3406 http://www.maricopa.gov/Assessor
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 Maricopa County Department of Emergency Management and at Logan Simpson Design Inc.

D.2. Maricopa County CWPP Contacts

Cristina Herrera
Emergency Services Planner
Department of Emergency Management
2035 N 52nd Street
Phoenix, Arizona 95008
(602) 273-1411
cristinaherrera@mail.maricopa.gov

Marcos Coria
Maricopa County
Regional Development Services Agency
301 W. Jefferson Street
Phoenix, AZ 85003
(602) 506-3011
mcoria@mail.maricopa.gov

Richard Remington
Senior Project Manager
Logan Simpson Design Inc.
33 N. Stone Ave., Suite 1460
Tucson, Arizona 85701
(520) 884-5500
rremington@lsdaz.com

Jared Wahlberg
GIS Technician II
Logan Simpson Design Inc.
51 W. Third Street, Suite 450
Tempe, AZ 85281
(480) 967-1343
jwahlberg@lsdaz.com

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 Maricopa 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 the *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 Maricopa 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 United States 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 Maricopa 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 that creates 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 that 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 aboveground portions of the plant and 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 setup 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, and headfires should be installed with temperatures of 65°F–95°F, 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 the 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 percent mix of Garlon with Ag. Oil has been successful with the exception of spring months when sap is moving up from the root mass (Parker and Williamson 2003). Extraction and mulching of saltcedar will require treatments of resprouts by mechanical or chemical control methods. Changes in nature of disturbance from fire (frequency, intensity, and severity) have been affected 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 and “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 creosotebush. See Cheatgrass section below for additional information.

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 nonnative components and loss of native plant species. Arizona interior chaparral communities are composed of varying plant species compositions, enhanced by the predominant bimodal rainfall patterns of Maricopa 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, (Hauser 2008) 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 and 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 reestablish 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 handheld 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 aboveground, 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 historical fire regimes and promote desired species. Historical 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 percent 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..

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 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 in 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 brittlebush (*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.

According to the Buffelgrass Working Group (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 5–10 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°C–700°C). Esque and others state that buffelgrass grows into an “almost-woody subshrub,” accumulating flammable material over several 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 as a medium threat level for Arizona’s wildlands. A medium ranking means that these species have a substantial impact on 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.

Marc Rounsaville
USDA-Forest Service
Fire and Aviation Management
Deputy Director

Timothy M. Murphy
Bureau of Land Management
Fire and Aviation
Deputy Director

for Lyle Carlile
Bureau of Indian Affairs
Fire Director

Brian McManus
U. S. Fish and Wildlife Service
Fire Director

Mike Wallace
National Park Service
Fire Director

for Dan Smith
National Association of State Foresters
Fire Director