Shasta West Watershed
Strategic Fuels Management Plan

Western Shasta Resource Conservation District

This project was funded through a grant from the USDA Forest Service – National Fire Plan Community and Private Land Fire Assistance Program

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Cover photo: Middle Creek Watershed, Mule Town Road Shaded Fuel Break

SHASTA WEST WATERSHED STRATEGIC FUEL MANAGEMENT PLAN

I. EXECUTIVE SUMMARY

Historically, wildfire has played a natural part in the evolution of vegetation in the 30,400-acre Shasta West Watershed. With increased urbanization of the watershed, a natural fire disturbance regime is increasingly less desirable. Successful fire suppression activities for the past eighty years have significantly increased the volume of vegetation across the landscape. The California Department of Forestry & Fire Protection (CDF) has determined the Fire Hazard Severity Zones to be High to Very High in the watershed (see Map #1).

The number and size of devastating wildfires impacting the western United States over the past ten years resulted in the creation of a National Fire Plan for the U. S. Departments of Interior and Agriculture. Funding was made available through the National Fire Plan, California Fire Plan and other agencies to assist local communities and watershed groups in identifying/planning and implementing fuel reduction projects. The *Shasta West Strategic Fuel Management Plan* was prepared by the Western Shasta Resource Conservation District under a grant from the United States Department of Agriculture (USDA) Forest Service – National Fire Plan Community and Private Land Fire Assistance Program.

A Technical Advisory Committee (TAC) consisting of representatives from local, federal, and state agencies, a local Service Guild, and landowners reviewed fuel load data, resources at risk, and current and planned fuel management activities. The group then identified areas of concern and developed management strategies to address the concerns. This plan is a compilation of the management strategies developed by the TAC, and later prioritized by the watershed community.

The purpose of this plan is to identify and lay out a network for the construction of shaded fuel breaks and ridgetop fuel breaks, and to identify other community activities that can increase protection for those living in the Shasta West Watershed area, protect values at risk, provide firefighter safety when containing a blaze, allow residents safe transportation routes away from a wildfire, and encourage a plan to maintain fuel break effectiveness and to continue to implement this fuel management plan.

This plan includes values at risk within the watershed and addresses landowner objectives, fuel treatments, the road system, potential funding sources, proposed fuel reduction projects, and previous fuel break locations used as links to develop the fuel break system. Recommendations include strategically placed shaded fuel breaks, a community evacuation plan, fire safety inspections, fire repellent product evaluation, establishment of a neighborhood coordinator program, hazard and fuel reduction education activities, neighborhood fuel reduction activities, road status evaluation, and obtaining accurate fuels data.

This plan focuses on the rural and rural/urban interface areas of the watershed, and does not attempt to address fuel management activities within urban areas managed by the City of Redding, which has developed its own urban fire defense strategy. More information regarding the City of Redding fire defense strategy can be found by contacting:

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II. BACKGROUND

A. INTRODUCTION

In 2001 the USDA Forest Service-National Fire Plan Community and Private Land Fire Assistance Program awarded funding to the Western Shasta Resource Conservation District (WSRCD) to prepare a Strategic Fuel Management Plan for the Shasta West Watershed. WSRCD has completed other strategic fuels reduction plans in the district for the Upper and Lower Clear Creek Watersheds, the Cow Creek Watershed and the Cottonwood Creek Watershed.

The Shasta West Watershed is the area west of the Sacramento River and Redding that includes the drainages of Rock Creek, Middle Creek, Salt Creek, Jenny Creek, Downtown Redding, Canyon Creek, Oregon Gulch and Olney Creek. Creeks in the watershed all flow into the Sacramento River.

The watershed covers a total area of about 47 square miles or about 30,400 acres. Elevation ranges from 430 feet at the Sacramento River to 2,325 feet at the top of Mule Mountain along the northwestern edge of the watershed. The communities of Shasta, Centerville and downtown Redding are within the watershed. Land ownership is primarily private, with the exception of the extreme western edge, which is managed by the Whiskeytown Unit of the National Park Service (NPS), and scattered sections throughout the watershed managed by the Bureau of Land Management (BLM).

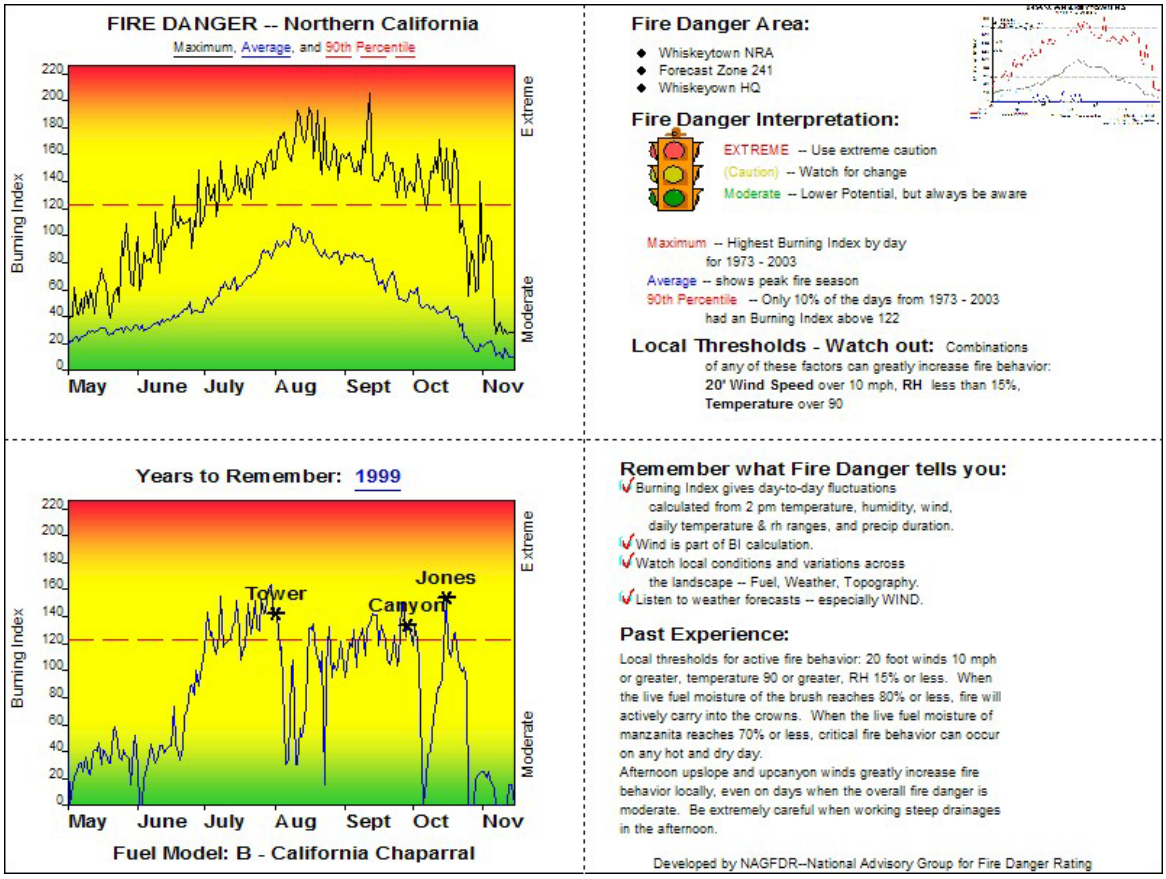
B. STATEMENT OF NEED

Shasta West is considered a Very High Fire Hazard Severity Zone as defined by CDF on the Shasta County Fire Hazard Map and recognized in a 1994 *Strategic Wildfire Defense Plan for the Middle Creek Watershed* prepared for the WSRCD. The watershed has not burned recently, but several fires have occurred in the last 25 years (see Map #2). A large percentage of the watershed has not burned in the last 60 years, and local fire agencies are very concerned with the level of fuel accumulation.

The watershed is also classified by the California Department of Forestry and Fire Protection (CDF) as Wildland Urban Interface (called the I-Zone), an area where homes are nestled throughout rugged topography of ridges and canyons and extensive wildland fuels. Prototype fires occurring in I-Zone areas are hot, fast moving and highly destructive to both wildland resources and man-made improvements. Fuel accumulation and lack of defensible space are critical factors in fire losses. Urban problems of density, access, water supply, and evacuation routes are compounded in these areas of rugged topography. The area is characterized by poor road access for fire fighting equipment, even with the proliferation of single-family homes and driveways throughout the watershed in the past ten years.

The watershed has a typical Mediterranean climate with long hot days from late spring to mid-fall with intermittent rain and snow during the cooler season. Below 2,000 feet elevation snow seldom remains longer than a few days. Annual average precipitation as measured by the Bureau of Reclamation (BOR) at Shasta Dam for the period of 1983 through 1993 is 51.2 inches. Summer daytime humidity readings can reach lows of 15 percent or lower. The watershed experiences extreme fire weather conditions, especially from May until September when the high temperature range is between 95-115 degrees F. Frequent strong zonal north winds occur throughout the summer; dry lightning storms occur most years; and dry foehn winds are common in the late summer and throughout the fall. Figure 1 demonstrates the level of seasonal fire danger.

FIGURE 1



Wildfire has historically been a natural influence on the landscape within the watershed. Before the influence of humans, wildfires started from lightning strikes fanned by hot dry winds, and spread across large tracts of land before burning out. Some conifer species (e.g., Knobcone pines) require fire, heat, or stress for seed dissemination and germination. Such frequent, low intensity fires burn quickly through underbrush, preserving large trees and maintaining diverse, multistory forests. Fire management practices over the past eighty years, however, have suppressed fire within the watershed and have profoundly affected the structure and composition of vegetation. Vegetation has become denser, mainly in small- and medium-size classes of shade-tolerant and fire-sensitive species. Additionally, dead and downed trees increase the amount of fuel on the ground. One consequence of these changes has been a large increase in the amount and continuity of both live and dead fuels, resulting in a substantial increase in the probability of large, severe wildfires. The conditions are now set for hot stand-replacement type fires that consume underbrush, overstory trees, and the duff layer. Stand-replacement type fires burn hotter, longer, and are usually more difficult to control. Fire size is predicted to increase with these conditions, including in the Shasta West Watershed.

An example of the ferocity of wildfires in this area is the High Fire Complex, which occurred in 2000, burning over 38,086 acres northwest of Redding and Shasta Lake on USDA Forest Service land. The estimated suppression cost of the fire exceeded $21 million. During the fire's 12-day run, over 40 additional fires burned an additional 4,700 acres throughout Shasta County. Another example is the Jones Fire, a wind-driven fire, which quickly traveled 17 miles, burned 26,202 acres, and destroyed 176 homes, 63 barns, 2 churches, 115 garages, 90 RVs and boats, 422 outbuildings and 123 vehicles. The damage estimate was $32.9 million and suppression costs exceeded $6 million.

In general, catastrophic wildfire is a major issue biologically, as the watershed provides suitable habitat for a wide variety of wildlife species. Tributaries in the watershed drain into the Sacramento River, which is habitat for the Federal and State endangered winter-run and spring-run Chinook salmon, and steelhead.

A sustainable diversified environment throughout the Shasta West Watershed depends on ecological decisions that are socially acceptable, economically feasible, and environmentally sound. A strategic fuels management plan is an important part of attaining a sustainable solution to the dangerous fuel problem.

C. GOALS AND OBJECTIVES OF THE PLAN

The purpose of this plan is to collect data, review surveys, consult with other agencies and conduct a literature review sufficient to produce a written Strategic Fuels Reduction Plan for the 30,400-acre Shasta West Watershed.

Goals and Objectives include:

- Recognize, protect, and enhance citizen and firefighter safety, watershed ecological and landscape values including water, timber, wildlife and habitat (which includes rare and endangered species), unique areas (scenic, cultural, and

historic), recreation, range, structures, air quality, and reduce fire associated impacts to soils.
    - Reduce potential fire intensity and duration to levels below those likely to kill large trees or damage other highly valued landscape features.
    - Prevent structure or yard fires from escaping to surrounding wild areas.
    - Allow initial attack suppression forces opportunity to prevent the spread of fire starts.
- Identify those areas of concentrated assets and high risks:
    - Minimize private property losses and risks to human safety.
    - Minimize the risk of fire starts.
- Identify where cost-effective prefire management investments can be made to reduce taxpayer costs, citizen losses, and environmental impacts from wildfire:
- Reduce the rate of spread and resistance to control of wildfire with emphasis on ridgelines, internal routes of travel and modification of large blocks of volatile fuels.
- Minimize the potential of wildfire burning into the watershed.
    - Develop and maintain effective fire-safe standards and practices around structures, residential areas, and in the vicinity of roads to reduce fire risk and provide effective protection from wildland fire.
    - Identify and coordinate agency and landowner fire prevention and control responsibilities and capabilities.
- Foster and maintain multi-agency and landowner roles and responsibilities in the implementation and maintenance of this plan.

D. METHODOLOGY

The activities necessary for the development of the Strategic Fuels Management Plan include:

- Meeting with Shasta West Watershed Group members, landowners and stakeholders to determine the scope of a fuels management plan;
- Researching local fire history;
- Evaluating values at risk, such as structures and natural resources;
- Presenting data to the Shasta West Technical Advisory Committee (TAC), which includes representatives from CDF and the local fire departments, for review and assistance in prioritization;
- Coordinating with agencies on their management objectives in the watershed;
- Identifying long term maintenance options for fuel breaks;
- Identifying mechanical treatment areas and possible uses of excess fuels;
- Developing a priority list of recommendations and potential funding sources;
- Completing a draft fuel management plan for review by the TAC;
- Presenting a draft fuel management plan to the community through the Shasta West Watershed Group;
- Incorporating recommendations and issuing a final plan.

III. SUPPORTING PLANS, ORGANIZATIONS AND AGENCIES

A. NATIONAL FIRE PLAN

In 2001 the Chief of the USDA Forest Service published a *National Fire Plan* (U.S. Department of Interior and U.S. Department of Agriculture, 2001), which is a cohesive strategy for improving the resilience and sustainability of forests and grasslands at risk, for conserving priority watersheds, species and biodiversity, reducing wildland fire costs, losses and damages, and to better ensure public and firefighter safety. To achieve these goals, work began to improve firefighting readiness, prevention through education, rehabilitation of watershed functions, hazardous fuel reduction, restoration, collaborative stewardship, monitoring jobs, and applied research and technology transfer.

The objective of the National Fire Plan is to describe actions that could restore healthy, diverse, and resilient ecological systems to minimize the potential for uncharacteristically intense fires on a priority basis. Methods include removal of excessive vegetation and dead fuels through thinning, prescribed fire and other treatment methods. The focus of the strategy is on restoring ecosystems that evolved with frequently occurring, low intensity fires. These fires typically occurred at intervals of between 1-35 years and served to reduce the growth of brush and other understory vegetation while generally leaving larger, older trees intact. The report is based on the premise that sustainable resources depend on healthy, properly functioning, resilient ecosystems. The first priority for restoration is the millions of acres of already roaded and managed landscapes that are in close proximity to communities. More information about the National Fire Plan is available on the Internet at www.fireplan.gov.

B. CALIFORNIA FIRE PLAN

The California Fire Plan has five strategic objectives:

- Create wildfire protection zones that reduce risks to citizens and firefighters.
- Assess all wildlands (not just the state responsibility areas) to identify high risk, high-value areas and develop information and determine who is responsible, who is responding, and who is paying for wildland fire emergencies.
- Identify and analyze key policy issues and develop recommendations for changes in public policy.
- Develop a strong fiscal policy focus and monitor wildland fire protection in fiscal terms.
- Translate the analyses into public policies.

A key product of the Fire Plan is the identification and development of wildfire safety zones to reduce citizen and firefighter risks from future large wildfires. Initial attack success is measured by the percentage of fires that are successfully controlled before unacceptable costs are incurred. Assets at risk are identified and include citizen and firefighter safety, watersheds, water, timber, wildlife, habitat, unique areas, recreation, range structures, and air quality. Air quality is a factor because, based on the annual average acres burned by wildfires from 1985-1994, CDF calculates wildfires emit almost 600,000 tons of air pollutants each year.

The safety and asset assessments in the plan enable fire service managers and stakeholders to set priorities for prefire management project work. Prefire management includes a combination of fuels reduction, ignition management, fire-safe engineering activities and improvements to forest health to protect public and private assets. CDF finds there is a direct relationship between reduced expenditures for prefire management and suppression and increased emergency fund expenditures, disaster funding, and private taxpayers' expenditures and losses.

California Department of Forestry and Fire Protection (CDF) is responsible for fire suppression on privately-owned wildlands and provides emergency services under cooperative agreements with the counties.

In 2000 the State Board of Forestry and CDF completed a comprehensive update of the state fire plan for wildland fire protection in California. The overall goal of the plan is to reduce total costs and losses from wildland fire by protecting assets at risk through focused prefire management prescriptions and increasing initial attack success. CDF's statewide Initial Attack Fire Policy is to aggressively attack all wildfires, with the goal of containing 95% of all fire starts to 10 acres or less.

In the Shasta West Watershed, CDF shares responsibility for wildland fire protection with the National Park Service and the Bureau of Land Management on all ownerships, except those managed by the Whiskeytown National Recreation Area (WNRA) in the southern section of the watershed. CDF and the WNRA have entered into a cooperative agreement for dispatching and resource sharing on all wildland fires occurring in the "mutual threat zone" near WNRA. The cooperative agreement, in conjunction with the California Cooperative Fire Agreement on Wildland Fire Suppression between CDF, NPS, and BLM, outlines the cooperative sharing of resources for wildland fire suppression, since wildfires do not recognize political or ownership boundaries.

In summary, CDF believes that cooperative fire protection, fuels reduction, and fire prevention must be linked in order to have future success in dealing with the wildfire problems within the Shasta West Watershed.

C. SHASTA COUNTY FIRE SAFE COUNCIL

The Shasta County Fire Safe Council was formed in May 2002 as part of a statewide effort that began in 1993 to form area Fire Safe Councils across the state to educate and encourage Californians to prepare for wildfires before they occur. (See www.firesafecouncil.org for more information.) The mission of the Shasta County Fire Safe Council is to be a framework for coordination, communication and support to decrease catastrophic wildfire throughout Shasta County. The group meets quarterly to discuss projects, share information, schedule speaking engagements, develop educational opportunities, and update maps showing fuels reduction projects and maintenance throughout the county.

D. BUREAU OF LAND MANAGEMENT

The BLM administers approximately 4,062 acres or 14% of the land in the Shasta West Watershed (see Map #3) as part of the Shasta Management Area (SMA) in accordance with management strategies outlined in the *Redding Resource Management Plan* completed in 1993. Within the SMA is a special management area located in the Shasta West Watershed, known as the Swasey Drive Area of Critical Environmental Concern (ACEC). A management objective for this ACEC is to conserve and interpret the prehistoric and historic archaeological resources located on site.

All BLM lands with burnable vegetation must have an approved Fire Management Plan (FMP), a strategic plan that defines a program to manage the wildland and prescribed fires based on the area's approved Land Management Plan (U. S. Department of Interior, U.S. Department of Agriculture, 2002). The FMP provides for firefighter and public safety; includes fire management strategies, tactics and alternatives; addresses values to be protected and public health issues; and is consistent with resource management objectives, activities of the area and environmental laws and regulations. At this time an FMP has not been approved and BLM units must take aggressive suppression action on all wildland fires consistent with firefighter safety and public safety and resources to be protected.

The BLM Fire Management Officer is responsible and accountable for providing leadership for the BLM fire and aviation management program at the local level. The BLM strategically focuses fuel treatment activities by placing priorities on areas where actions will mitigate threats to the safety of employees and the public; areas where actions will protect, enhance, restore and/or maintain plant communities and habitats that are critical for endangered, threatened or sensitive plant and animal species; and areas where actions will reduce risks and damage from a wildfire.

Although structural fire suppression is the responsibility of tribal, state or local governments, BLM may assist with exterior structural protection activities under a formal agreement with CDF. There are three categories of structures: those not threatened; those threatened; those lost or too dangerous to protect. In the wildland-urban interface, BLM lists several "Watch Outs" that assist personnel in sizing up a wildfire situation. These "watch outs" may be beneficial to readers of this report in assessing the fire-safe condition of personal property. "Watch out" for:

- Wooden construction and wood shake roofs
- Poor access and narrow one-way canyons
- Bridge weight and size limits when using heavy equipment
- Inadequate water supply
- Natural fuels 30 feet or closer to a structure
- Evacuations of public, livestock, pets, animals (planned or occurring)
- Power lines and poles overhead and fallen lines
- Propane and above-ground fuel tanks with nearby vegetation or wooden improvements
- Local citizens attempting suppression actions
- Level of coordination with multiple agencies.

E. WHISKEYTOWN NATIONAL RECREATION AREA (WNRA)

The National Park Service (NPS) administers approximately 700 acres or 2.4% of the Shasta West Watershed as part of the Whiskeytown Unit of the Whiskeytown-Shasta Trinity National Recreation Area (See Map #3).

Decades of fire suppression have led to a volatile increase in fuels, and excessive amounts of flammable vegetation, and dead and downed debris throughout WNRA. The ability of a fuel break to slow the spread of a high intensity fire also gives firefighters the ability to halt the spread of a low intensity fire.

Whiskeytown's fuel break plan is part of a growing network of interconnected fuel breaks designed by CDF, BLM, WSRCD, California Department of Corrections, NPS and local residents. These groups are working together to design and implement a system based on interagency partnership and cooperation. The partnerships enable fuel breaks to stretch across boundaries and, in effect, reduce the chance of significant losses over a greater area.

Before work on a fuel break can begin, fire ecologists, fire management officers, and park mangers pinpoint where the use of a fuel break would be the most effective. The main factor taken into consideration is location. Ridge tops and roadways are typically the primary location for a fuel break, since these areas are known to be key firefighting locations. By installing fuel breaks along ridges and roads, it can lessen the intensity of a wildfire and perhaps even halt its spread. Once the location of a fuel break is designated, environmental documentation is complete, and the area is flagged, a supervised crew begins construction. Brush is first cut and then piled in cleared areas away from trees for burning later. Shading from trees left in the fuel break help reduce the intensity of a fire by lowering the temperature at the fuel break site. The use of prescribed fires can help introduce low intensity fires back into the landscape. Using fuel breaks in conjunction with prescribed fires can help firefighters' ability to slow or stop a fire from spreading across boundaries into undesirable areas or conditions.

In November 2001, NPS completed the 720-acre Sunshine Prescribed Burn, the first significant burn completed in the WNRA in three years. The burn was an interagency project to help reduce the threat of wildfire to the community of Old Shasta and west Redding and enhance the effectiveness of fuel breaks already in place outside the WNRA boundary.

The 1993 *Whiskeytown Fire Management Plan* was updated in 2002 after completion of an Environmental Impact Statement, and outlines the WNRA fire goals for the next 10 years. A broad range of new issues, improved information and technology, and unforeseeable limitations have emerged, which have the potential to affect the future direction of the fire management program within the park. Some of these issues include a continued decline in ecosystem health due to fire suppression; increased hazardous fuels buildup; expanded use and development in the wildland-urban interface; increased risk and cost associated with fire suppression; increased interest in mechanical manipulation, especially in accessible areas; and more stringent air quality regulations.

F. CITY OF REDDING

Approximately 48% of the watershed (14,157 acres) is located within City of Redding boundaries. The City of Redding's Fire Prevention Division is responsible for administering activities that include fire prevention inspections, vegetation management, plan review, public education, fire investigations, and community safety evaluations. The Division is staffed with one Deputy Chief/Fire Marshal, one Assistant Fire Marshal, one Fire Inspector, and one Fire Prevention Aide.

The City of Redding contains a large area of wildland interface and intermix area that has been designated as a "Very High Fire Hazard Severity Zone" by CDF. This area is included in the vegetation management program, in which the City works with parcel owners on a self-inspection program to ensure owners comply with vegetation management criteria.

The 2000-2020 *General Plan* was adopted in 2002 and outlines the City's Urban and Wildland Fire Hazard goal and policies. As stated in the Plan, the City's goal is to "Minimize the potential for loss of life, injury and property damage resulting from urban and wildland fires."

Policies to achieve the goal include:

- Maintain an Insurance Service Office rating of 3 or better.
- Require all new development and redevelopment to meet State and local fire protection standards.
- Ensure water district systems are developed, maintained and monitored to provide capacity for fire suppression.
- Require remote hillside developments to maintain sufficient wildland fire protection water supplies on site when appropriate.
- Utilize appropriate fuel management techniques and structural fire protection measures to reduce fire damage in high wildland fire potential areas.
- Within developments, construct emergency-vehicle access routes to open-space areas.
- Develop a vegetation management and weed abatement program for open-space areas.
- Consider establishing a fire-access road program in very high fire danger ravine areas.
- Amend subdivision regulations to ensure cul-de-sac lengths are generally no greater than 600 feet and have sufficient emergency-vehicle turnaround areas.
- Generally require residential developments with 50 or more dwelling units and commercial developments with 150 or more employees to have at least two connected points of public access.
- Maintain and augment mutual and automatic aid agreements with the CDF and Shasta County.
- Promote fire prevention through education and public-awareness programs.

The Fire Department processes approximately 100 requests for public education presentations each year, with activities ranging from fire station visits and tours, to on job site safety presentations. In conjunction with the Shasta County Fire Prevention Officers'

Association, the Department participates in conducting public education demonstrations at schools throughout the County. These presentations include visits from Sparky the Fire Dog; the ever popular Smokey Bear; Pluggie, the talking fire hydrant; and Big Red, a specifically equipped fully operational fire engine dedicated to public education activities.

IV. ANALYSIS OF FUEL INVENTORY AND CONDITIONS

A. FUELS, WEATHER AND TOPOGRAPHY

The three major components of the wildland fire environment are fuels, weather, and topography (National Wildland Coordination Group, 1994). Weather is a major factor and local weather conditions are important in predicting how a fire will behave.

Within the lower elevations of the Shasta West Watershed, the wind blows from the north during the early part of the summer and from the south during the latter part of the summer, and in the western foothills, the wind trends up the canyons on the hillsides east to west. In the valley the wind patterns push wildfire in a northerly or southerly direction and westerly direction in the foothills. From a strategic standpoint, fire spread in lower elevations can most likely be decreased by an east-west fuelbreak or area to set up control lines. To hold valley fires from being pulled up through gullies or 'chimneys' in the foothills, strategically placed fuelbreaks near the foothills in a northerly/southerly direction can be beneficial.

Topography can affect the direction and the rate of fire spread. Topographic factors important to fire behavior are elevation, aspect, steepness and shape of the slope. When fire crews are considering fire suppression methods, the topography is always critical in determining the safest and most effective plan of attack. When accessible, ridge lines are very important features from which to conduct fire suppression activities and can be a strategic area to conduct fuels management activities.

Fuel factors that influence fire behavior are: fuel moisture, fuel loading, size, compactness, horizontal continuity, vertical continuity, and chemical content. (National Wildfire Coordinating Group 1994)

- Fuel moisture in this case is the amount of water in a fuel sample, expressed as a percentage of the green weight of that fuel. A fuel with less than 30% moisture content is considered a "dead" fuel, while "live" fuels will range from 30 to 60 percent moisture content, depending on the plant's stage of growth in a season.
- Fuel loading is defined as the ovendry weight of fuels in a given area, usually expressed in bone dry tons. For example, an area can be calculated to have 20 bone dry tons per acre of fuel. A bone dry ton is 2000 pounds of vegetation when rated at 0% moisture content.
- Size refers to the dimension of fuels, and compactness refers to the spacing between fuel particles.

- Continuity is defined as the proximity of fuels to each other, vertically or horizontally, that governs of the fire's capability to sustain itself.
- Chemical content in fuels can either retard or increase the rate of combustion.

All of these factors will influence the quantity of heat delivered, the duration, flame length and the rate of spread of any given fire, and should be considered prior to considering pre-fire projects or initiating fire suppression activities.

According to historical fire data from the CDF and the USDA Forest Service, the Shasta West Watershed experienced large acreage fires in the decades of 1940-1970 (See Map #2). Data from this time period regarding small fires is incomplete. According to descriptions of fire history in the *Upper Clear Creek Late Successional Reserve* (Forest Service 1997), Forest Service records were made only of those fires that received some type of fire suppression action; fires that had no suppression activity or that went out due to natural causes were not recorded. The CDF database is also historically incomplete because it does not record fires less than 300 acres and does not contain fire starts prior to 1985.

As shown in Table 1, Recent CDF data identifies at least 182 fires, and their causes, in the Shasta West Watershed between 1990 and 2002. Fires were between 0-50 acres, with 15 being greater than 1 acre in size. Large acreage fires have not occurred in the watershed during this time period. Local fire agencies have identified the high level of fuel build up as a major concern for the area in regard to fire danger.

TABLE 1 - INCIDENCE OF FIRES IN THE SHASTA WEST WATERSHED (FROM CDF)

Year	*Number of Fire Starts*
1990	13
1991	12
1992	19
1993	14
1994	14
1995	16
1996	15
1997	16
1998	13
1999	14
2000	15
2001	9
2002	12
Total	182

CAUSE (1990-2002)	
Unidentified	16
Lightning	7
Campfire	2
Smoking	11
Debris or garbage	20
Arson	34
Equipment use	22
Play w/ Fire	18
Miscellaneous	30
Vehicle	17
Power line	5
Total	182

B. FUEL INVENTORY

Fuels are made up of various components of vegetation, live and dead, that occur on a given site. Fuels have been classified into four groups – grass, shrub, timber litter, and slash. The differences in fire behavior among these groups are related to the fuel load and its distribution among the fuel diameter-size class. In 1972, 13 mathematical fire behavior models or Fuel Models were developed by Rothermel to be utilized in fire behavior predictions and applications for every vegetation type. These Fuel Models represent the types of fuel most likely to support a wildfire.

Fuel models represent what type of fuel will most likely support fire. Fuel models 1-3 are grass or grass dominated, 4-7 are shrub dominated, 8-10 are timber litter, and 11-13 are slash dominated. The fuel models were identified based on the publication "Aids to Determining Fuel Models for Estimating Fire Behavior" by Anderson, 1982.

TABLE 2 - FUEL MODELS FOR ESTIMATING FIRE BEHAVIOR

Fuel Model	Fuel Complex	Found in Shasta County?
	Grass and Grass-Dominated	
1	Short Grass (1 foot)	Yes
2	Timber (grass and understory)	Yes
3	Tall Grass (2.5 feet)	No
	Chaparral and shrub fields	
4	Mature brush with considerable amounts of dead fuel	Yes
5	Young brush with very little dead fuel	Yes
6	Dormant brush	Yes
7	Southern rough	No
	Timber litter	
8	Short needle conifer and hardwood litter	Yes
9	Long needle conifer and black oak litter	Yes
10	Timber litter greater than 3 inches	Yes
	Slash	
11	Light logging slash	Yes
12	Medium logging slash	Yes
13	Heavy logging slash	Yes

The fuel models were designed to predict fire behavior for specific weather and fuel conditions. They are accurate throughout a broad range of climates, but tend to under predict the spread and intensity of fire during extreme conditions (high winds combined with very low relative humidity). Fuel models are tools to help the user realistically estimate fire behavior. The criteria for choosing a fuel model includes the assumption

that fire burns in the fuel stratum best conditioned to support the fire. This means that situations will occur where one fuel model will represent the rate of spread most accurately, while another best depicts fire intensity. In other situations, two different fuel conditions may exist, so the spread of fire across the area must be weighed by the fraction of the area occupied by each fuel type.

Precise forecasting of fuel models for the watershed is not possible without accurate vegetation data. Consultation with CDF, Redding, and ground truthing by CDF and WSRCD staff determined the CDF Fire and Resource Assessment Program (FRAP) vegetation data for the majority of the Shasta West Watershed to be inaccurate. Most of the area below the 1,500 foot elevation line is shown on the FRAP maps as grass. On-the-ground investigation shows it to be brush or an oak – pine overstory with a brush understory.

Using the fuel models described by Rothermel in 1972 (Table 3), models for this report have been determined by using on-site "grab samples" obtained in the field. This data was generated by sampling eleven sites scattered throughout the watershed.

Stop #1: Turn out on Hwy. 299, about one eighth mile east of the Rock Creek Road intersection. Vegetation is an overstory of knobcone pine, with an understory of young brush (mostly manzanita and toyon). Fuel Models are 6 and 8.

Stop #1 Looking North

Stop #2: 0.3 miles west of Rock Creek Road, on Miners Gulch Road. Vegetation is an overstory of knobcone pine, with an understory of manzanita and toyon and is Fuel Model 6. The next drainage to the north is Fuel Model 4.

Stop #2 Looking West

Stop #3: Benson Road, one tenth mile north of the intersection with Rock Creek Road. Vegetation is grass for a 50 foot swath along both sides of the road. Away from the road, the vegetation goes into an overstory of ponderosa pine, with an understory of brush. The grass is Fuel Model 2, and the brush is Fuel Model 4.

Stop #3 Looking East

Stop #4: Benson Road, one mile from Rock Creek Road. Oak and pine overstory, with manzanita and toyon understory. Fuel Model 4, starting from the roadway. Ponderosa pine on the ridge to the west, with brush understory is Fuel Model 4.

Stop #4 Looking South

Stop #5: Turn out on Iron Mountain Road, south of the quarry. Oak – pine overstory with a manzanita toyon understory. The brush condition dictates a Fuel Model #4. Most of the area along Rock Creek Road and along Iron Mountain Road is Fuel Model 4.

Stop #5 Looking Southwest

Stop #5 Looking Northwest

There is a significant invasion of non-native, invasive Ailanthus (tree-of-heaven) along Iron Mountain Road.

Stop #6: Station 58. Surrounding vegetation is an oak overstory, with manzanita and toyon understory is Fuel Model 4.

Stop #6 Looking North

Stop #7: Intersection of Lower Springs Road and Swasey Drive. Vegetation is an overstory of oak and grey pine, with a thick understory of manzanita and toyon, Fuel Model 4. A control burn could convert this area into an oak - pine woodland quite easily. Toyon will be difficult to control.

Stop #7 Looking West

Swasey Drive south of the Lower Springs Road intersection has heavy fuel loading on both sides of the road, Fuel Model 4.

Stop #8: BLM shooting range access road, 0.3 miles west of Swasey Drive. The flatter bottoms are Fuel Model 2, the hills are Fuel Model 4. The stream drainage area is much heavier vegetation. Vegetation on the hillsides is oak woodland, with the understory brush Fuel Model 4, and in the lighter areas Fuel Model 6. This area would lend itself to the creation of an oak savannah gradating into a ponderosa pine forest on the upper ridges.

Stop #8 Looking North

Stop #8 Looking South

Stop #9: Trail Drive, east of Simmons Road, about 1.25 miles south of Placer Road. Vegetation is an oak overstory with grass understory. Pockets of brush in some areas. Fuel Model is 8 over Fuel Model 2. The brush pockets are a Fuel Model 4.

Stop #9 Looking North

Stop #9 Looking South

Stop #10: End of Silver King Road, about 0.75 miles south of Placer Road. Vegetation is oak woodland overstory with grass and light brush, and pockets of heavy brush. Fuel Models are 2, 4, 6, and 8. The area was previously grazed about 20 to 25 years ago. This is another prime area that could be returned to oak savannah.

Stop #10 Looking West

Stop #10 Looking East

Stop # 11 Texas Springs Road, one fourth mile east of Placer Road is Fuel Model 2.

Stop #11 Looking South

Stop # 11 Looking North, notice the mowed grass for wildfire defense.

V. VALUES AT RISK

A. RESIDENCES

According to the 2000 Census, residential land use makes up 55% (16,163 acres) of the watershed. The two rural population centers are the community of Centerville and the historic town of Shasta. An estimated 850 residences were located throughout the rural area of the watershed in 2001. The area is being rapidly developed, resulting in a continual increase in population. As more people build homes in zones with high and severe fire hazard severity potential (See Map #1), more lives are at risk from increased fire starts. As a result, many homes within the Shasta West Watershed are surrounded by dense fuels and severe fire hazard. Building design, maintenance around homes, and wildfire defense planning can significantly influence the impacts of wildfires.

The assets at risk from fire consist primarily of the many homes that are located throughout the area. The residences are primarily houses located on large lots, ranchette style homes with small acreage, and ranches with houses and outbuildings located on the property.

B. HISTORIC AREA

The 19-acre Shasta State Historic Park is located in the historic town of Shasta. The park includes historic trails and roads, cottage ruins, gardens, orchards and a Catholic Cemetery, where many of Shasta's prominent citizens are buried. Historic structures include the Courthouse Museum and Art Gallery, Jail, and Pioneer Barn.

The restored museum building served as the Shasta County Courthouse for three decades in the late 1800s. Today, the building houses the visitor center and information desk, and a collection of historic California artwork. The courtroom, jail, and gallows have been restored and furnished with many original items to interpret Shasta County justice in the days of the gold rush. The Pioneer Barn area houses farming and mining implements of the 1800s, an original stagecoach and other agricultural supplies.

In the town of Old Shasta, the old business district dates back to the 1850s

C. NATIONAL RECREATION AREA

Approximately 700 acres of Whiskeytown National Recreation Area (WNRA) is within the watershed. WNRA, with its mountainous back country and large, man-made reservoir offers many summer activities such as hiking and boating, as well as historical remains of the California Gold Rush of 1849. Whiskeytown Lake provides 36 miles of shoreline and 3,200 surface acres of water, and is excellent for most water-related activities, including swimming, scuba diving, water skiing, boating and fishing. The lake was created by diverting water through tunnels and penstocks from the Trinity River Basin to the Sacramento River Basin. The most prominent landmark within the Recreation Area is Shasta Bally (elevation 6,209 feet). The summit may be reached on foot and by 4-wheel drive vehicle, but is closed in the winter. Picnicking, hiking, hunting, interpretive programs and horseback riding are also popular within the Whiskeytown Unit.

D. FISH AND WILDLIFE

The vegetative types within the watershed provide suitable habitat for a variety of wildlife species. Those known or expected to reside or forage in the area include blacktail deer, black bear, cougar, mountain lion, raccoon, striped skunk, mountain and California quail, band-tailed pigeon, scrub jay, and a variety of neotropical migratory bird species. Chinook salmon and steelhead are known to use Olney, Salt, and Middle Creeks for spawning, while all tributaries are important for non-natal rearing of these fish species. The winter run and spring run Chinook salmon in the adjacent Sacramento River are listed as a Federal and State endangered species. The adjacent Sacramento River is also used by fall and late fall Chinook salmon that are a candidate species being considered for federal listing, and the threatened Central Valley steelhead.

VI. FUEL TREATMENTS

A. INTRODUCTION

Reducing fuel loads is one of the most effective elements of any fire prevention and protection program. Managing fuel loading is critical to maintaining communities, ranches, grazing lands, riparian areas, and the overall health and function of the watershed. The ability to implement fuels reduction projects typically comes down to the source of funds available, the cost of labor, and the ability to implement the project.

Conducting fire safe and fuel reduction projects in wildland and interface areas must be sensitive to other resource values. Integrated pest management practices including noxious weed control should be considered in the planning phase of any fuel modification project. Additionally, projects should be designed to minimize erosion impacts.

One major reason for conducting fire safe and fuels reduction projects is to prevent large scale wildland fires that would remove major soil-protecting vegetation, duff, and litter. Once these components are removed from large acreages the soil is exposed to direct rainfall without protective coverings and frequently leads to flooding and the movement of sediment into the creeks. This fire/flood cycle has the potential to create major erosion

events on some soils and steep slopes when winter rains come. This erosion impacts watercourses and streams by depositing sediment where it is not wanted for other resource values, such as fisheries and water quality.

General soil erosion needs are addressed elsewhere in this plan. Onsite erosion control measures for specific projects will need to be developed to prevent and minimize erosion. This philosophy should be used in project design, layout, and follow-up.

Fuel reduction projects may involve a combination of methods from hand work to heavy machinery work. Prescribed fire and burning of piled brush may also take place to build fuelbreaks or to conduct area wide fuel reduction. All these activities may create erosion problems that must be addressed in light of the location, vegetation, amount of soil disturbance, and slopes. These potential impacts should be addressed on an individual project basis.

Laws and regulations that may be triggered by fuels reduction projects should be considered in project design, as it is imperative not to create an erosion problem while solving a fuels reduction or fire safe problem. Erosion control measures, such as mulching, seeding, erosion barrier construction, waterbars, rolling dips, and sediment traps etc. may be applied to project sites based on experience with the extent of soil disturbance, soil type, amount of litter remaining, rainfall intensity, and slopes.

Further information on erosion requirements can be obtained from the following agencies or organizations:

California Department of Fish and Game
601 Locust Street
Redding, California, 96001
Phone: (530) 225-2300
Fax: (530) 225-2381

California Department of Forestry and Fire Protection - Shasta-Trinity Unit
875 Cypress Avenue
Redding, California 96001
Phone: (530)225-2418
Fax: (530) 225-2419

Central Valley Regional Water Quality Control Board - Redding Branch Office
415 Knollcrest Drive, Suite 100
Redding, CA 96002-0129
Phone: (530) 224-4845
Fax: (530) 224-4857

City of Redding – Public Works Department, Engineering Division
777 Cypress Avenue
Redding, CA 96001
Phone: (530) 225-4170
Fax: (530) 245-7024

County of Shasta – Environmental Health Division
1855 Placer Street, Suite 201
Redding, California 96001
Phone: (530) 225-5787
Fax: (530) 225-5413

National Park Service – Whiskeytown National Recreation Area
P.O. Box 188
Whiskeytown, California 96095
Phone: (530) 242-3400
Fax: (530) 246-5154

Natural Resource Conservation Service - Redding Service Center
3644 Avtech Parkway
Redding, CA 96002-9241
(530) 226-2560
(530) 226-2567 fax

United States Department of Agriculture Forest Service – Shasta-Trinity Unit
Shasta-Trinity National Forest Headquarters
3644 Avtech Parkway
Redding, CA 96002
Phone: (530)226-2500
FAX: (530)226-2470

Western Shasta Resource Conservation District
6270 Parallel Road
Anderson, California 96007-4833
Phone: (530) 365-7332
Fax: (530) 365-7270

B. PRESCRIBED BURNING

The NPS has been conducting prescribed burns within the WNRA since 1994. CDF conducted prescribed fires on private land twice, first in 1983 and again in 1986. The advantages of prescribed fire are: it can be low cost to implement, it can be implemented over a large area, and it may decrease herbicide use by controlling the timing of sprouting. Some of the negative aspects of prescribed fire are: the potential for erosion, the smoke, the practice has a limited season, there is the risk of escape, it is not feasible in small areas, and it is not a stand-alone tool.

Prescribed fire is used to approximate the natural vegetative disturbance of periodic wildfire occurrence. This vegetative management tool is used to maintain fire dependent ecosystems and restore those outside their natural balance. Generally, low intensity prescribed fire is applied by trained experts to remove dangerous fuels like dead wood and brush. This low-intensity fire is vital to the life cycles of fire-dependent plants on range and forest lands.

Most prescribed fires are lit by crews using a drip torch, a hand-carried device that pours out a small stream of burning fuel. Other fires or burns are ignited by helicopters carrying a gelled fuel torch (helitorch) or a sphere dispenser machine that drops material to ignite the surface fuels in forest and range types. Exactly how each unit is ignited depends on weather, the lay of the land, and the intensity of the fire needed to meet the goal of the burn (USDA Forest Service 2002). The technique can be used to burn piles of cut brush or grass over a designated prepared area (broadcast burn).

Prescribed fire is useful in restoring and maintaining natural fire regimes in wildland areas, but logistic, economic, and social attributes are constraints on widespread deployment. Because of such conflicts, resource managers often employ mechanical fuel reduction, such as thinning, in conjunction with prescribed fire to reduce fuels and the fire hazard (Regents of the University of California 1996) (CDF 2002).

Prescribed fire is not without controversy and risk. A prescribed fire can get out of control and cause damage to watersheds, wildlife habitat, and structures, and can even result in loss of life. It is only an option when this risk can be reduced to manageable levels. Factors closely monitored to mitigate risk include:

- Fuel moisture content
- Ratio of dead-to-live fuel
- Fuel volume
- Size and arrangement of fuel
- Percentage of volatile extractives in the fuel
- Wind speed and direction
- Relative humidity
- Air temperature
- Topography

A successful prescribed burn must account for all these factors to prevent the fire from getting out of control. Guidelines for measuring the data and selecting the levels necessary to manage the prescribed fire are available from a variety of sources. One excellent reference for wildland-urban zones is the USDA Forest Service publication, *Burning by Prescription in Chaparral* (USDA Forest Service 1981).

Air quality is another consideration in the use of prescribed burning. Communities in the Urban-Wildland Interface are very sensitive to the presence of smoke. Burn days approved by state and local authorities take into consideration the meteorological effects on both fire severity and smoke dispersion. In the case of chaparral, prescribed burning for range improvement has been practiced by California landowners under permit from CDF since 1945 (Green 1981). Currently, procedures for prescribed burning require a

written plan for each burn. A plan includes such items as an objective, an area map, a description of the burn unit and surrounding areas, a smoke management plan, and the burn prescription (USDA Forest Service 1981).

Prescribed fire is the primary treatment method for all public lands, ranging from USFS land to state parks. According to FRRAP, the *Forest and Rangeland Resources Assessment Program* (Regents of the University of California 1996), most prescribed burns were to control brush, especially chaparral. Public agencies feel prescribed burns offer the lowest cost solution when considering the scale of the area requiring treatment. However, prescribed fires can be quite expensive when the true cost of planning, data gathering, reporting, and control and suppression are considered. Other major constraints are the reduction in allowable burn days because of increasing air quality concerns, high fuel load levels found in many forested and urban-wildland areas, and the increased production of pollutants, such as carbon monoxide, nitrous oxide, and particulates. In these situations, a combination of mechanical methods of fuel reduction combined with prescribed fire may provide the best solution.

C. SHADED FUEL BREAKS

Shaded fuel breaks are constructed as a means to create a defensible space in which firefighters can conduct relatively safe fire suppression activities. Fuel breaks may also slow a wildfire's progress enough to allow supplemental attack by firefighters. The main idea behind fuel break construction is to break up fuel continuity to prevent a fire from reaching the treetops, thus forcing the fire to stay on the ground where it can be more easily and safely extinguished. Fuel breaks may also be utilized to replace flammable vegetation with less flammable vegetation that burns less intensely. A well-designed shaded fuel break also provides an aesthetic setting for people and a desirable habitat for wildlife, in addition to fuels reduction. The California Board of Forestry has addressed the need to strengthen community fire defense systems, improve forest health and provide environmental protection. The Board rules allow a Registered Professional Forester (RPF) to use a special silviculture prescription when constructing or maintaining a community fuel break, exempts community fuel breaks from an assessment of maximum sustained production requirements and allows defensible space prescriptions to be used around structures.

The WSRCD has developed the following fuel break standards:

- The typical minimum width of a shaded fuel break is 100 feet, but can be up to 300 feet wide. The appropriate width is highly dependent on the slope, fuel density, fuel type, fuel arrangement, and landowner cooperation.
- Fuel breaks should be easily accessible by fire crews and equipment at several points. Rapid response and the ability to staff a fire line is very important for quick containment of a wildfire.
- The edges of a fuel break are varied to creating a mosaic or natural look. Where possible, fuel breaks should compliment natural or man-made barriers such as meadows, rock outcroppings, and roadways.
- A maintenance plan should be developed before construction of a fuel break. Although a fuel break can be constructed in a matter of a few weeks, maintenance must be conducted periodically to keep the fuel break functioning properly.

- The establishment of a shaded fuel break can lead to erosion if not properly constructed. Short ground cover, such as grass, should be maintained throughout the fuel break to protect the soil from erosion.
- A properly treated area should consist of well-spaced vegetation with little or no ground fuels and no understory brush. Tree crowns should be approximately 10-15' apart. The area should be characterized by an abundance of open space and have a 'park like look' after treatment.


Typical area in the watershed before fuel reduction


Similar area after establishing shaded fuel break

The Pile and Burn method is most commonly utilized when constructing fuel breaks. Material is cut and piled in open areas to be burned. Burning takes place under permit on appropriate burn days. Burn rings can be raked out after cooling as a means to decrease their visual effect.

In dealing with chaparral, a relatively new technique called "crush and burn" combines mechanical fuels treatment with burning. It is more effective in eliminating chaparral then a low-intensity prescribed burn, which has difficulty competing with the high moisture content of live chaparral. In this method, the chaparral is mechanically crushed, then piled and burned. It is a good technique for areas adjacent to communities and to encourage chaparral regeneration in riparian zones.

D. MECHANICAL TREATMENT

Using mechanized equipment for reducing fuels loads on suitable topography and with certain fuel types can be very effective. Depending on the use of the equipment, it may require environmental review and documentation. Using equipment to remove excess vegetation may enable the landowner to process the debris to a level where it can be marketed as a product for use in power generation. The debris then becomes labeled as "biomass" or "biofuels" and is further explained in Section IX of this report.

Mechanical methods to remove fuels include, but are not limited to, the utilization of bulldozers with or without brush rakes, excavators, chainsaws or mechanized falling machines, masticators, chippers, and grinders. Mechanical treatments are typically conducted on chaparral landscapes with some type of masticator, which grinds standing brush and reduces it to chips, which are typically left on the ground. Brush may also be mechanically removed and fed into a grinder for biomass production. Mechanical treatments are also utilized on industrial and non-industrial timberlands where trees are thinned by mechanized tree cutting or falling machines. In most cases, stands of trees are

thinned from below as a means to eliminate the fuels that can take a fire higher in the forest into the tree canopy (ladder fuels). However, stands of trees may also be thinned from above to eliminate crown continuity.

Mechanical treatments can be used successfully on stable ground up to 50% slope, but should only be conducted during dry periods when soils are not saturated to minimize erosion and compaction. The drastic visual impacts should be considered when planning projects so that all parties are aware of how the area will look when the project is completed. Initial planning should address mitigation for erosion potential, using measures such as waterbars, ditching, and mulching in critical areas. Furthermore, the impacts on wildlife and archaeological resources must be addressed.

Due to air quality concerns, the mechanical treatment method is fast becoming the acceptable method of fuel reduction in Wildland/Urban Interface areas. Compared to prescribed fire, mechanical treatment involves less risk, produces less air pollutants, is more aesthetically pleasing, and allows landowners to leave desirable vegetation.

E. MAINTENANCE TREATMENT

Maintenance plans for all existing shaded fuel breaks, as well as a maintenance strategy for all planned shaded fuel breaks need to be formulated as soon as funding can be made available. A maintenance section needs to be added to all planned shaded fuel breaks. Scrub oak and toyon re-sprouts, and manzanita seedlings on disturbed areas are typical of the vegetation needing control. Control can take many forms including chemical control, mechanical control, or grazing by livestock (such as goats).

The recommended time frame for maintenance is typically two years, five years and ten years after initial construction of the shaded fuel break. Treatment with livestock would need to be repeated more frequently. Re-growth is dependent on the quality of the site, the indigenous species, and of the length of time since the fuel break was constructed.

Periodic maintenance of a fuel break sustains its effectiveness. Seeding the fuel break with annual grass cover immediately following its construction will help reduce brush and conifer invasion, but only depending on grass cover will not eliminate invading plants for an extended period of time. Here are several methods to maintain fuel breaks:

1. Herbicides

The use of herbicides is a very effective and inexpensive method of eliminating unwanted vegetation, but should be used only as specified by the manufacturer. Using the correct herbicide, at the proper rate, and at the right time are important considerations. By federal law, every herbicide must be registered with the Environmental Protection Agency and be labeled with proper use and warning information. In addition, all commercial applications are required to be done by a licensed pesticide applicator.

2. Manual Treatment

Manual treatment is a very effective means to eliminate invading vegetation, but is very labor intensive. The cost of fuel break maintenance must be balanced with its degree of effectiveness. Depending on regrowth of the area, a rule of thumb for manual fuel break maintenance treatment might be one acre per day for an experienced 4 person crew. It is important to note that this can vary greatly depending on access to the site, topography, species type, density of vegetation and the specified treatment of the disposal of brush.

3. Herbivores

Herbivore (goat) grazing may be used as a means of maintaining fuel breaks, since goats will eat brush and weeds. Browse makes up about 60% of a goat's diet, but only about 10-15% of a cow's diet.

Goats used for fuel load reduction are managed to remove dense understory, including brush, shrubs, forbs, and lower branches to remove ladder fuels. It may require giving goats supplements of protein or energy, depending on the class of goats used and the time of year. The choice must be balanced on the type of soil, vegetation and livestock analysis. Monitoring of the herbivore grazing is critical since over-grazing can lead to erosion. A minimum effective goat herd has 500 animals, which will remove fuel from about 3 acres per day. The cost includes the goats, portable fencing, a goat herder, water and all transportation and daily supervision.

As goats work through an area they also work on the understory, old pine needles and leaves, break lower branches, and split apart old downed branch material. Once an area has been "brushed" by goats, it can be maintained as a living green belt. Fire control or containment with goats takes coordination of the stock owner, land steward, local fire patrol, professional fire abatement teams, CDF, DFG, and others.

Herbivores Used In Fuel Reduction

According to a report published by the North Carolina Cooperative Extension Service, grazing goats have been observed to select grass over clover, prefer browsing over grazing pastures, prefer foraging on rough and steep land than over flat, smooth land, graze along fence lines before grazing the center of a pasture, and graze the top of the pasture canopy fairly uniformly before grazing close to the soil level.

Herbivore grazing has been done in the Sierra Foothills by Goats Unlimited, Rackerby, CA. They report the vegetation in the Sierra Foothills grazing area consists of woody plants, shrubs, forbs and grasses. Before entering a new area, the herder develops a landscape goal, completes a vegetative survey and identifies toxic plants. They identify the growth habit and adaptation of each plant species, especially those that are toxic. The objective is to control the invasion of unwanted species and encourage perennial grasses to return. In a report published by Langston University, goats improve the cycling of plant nutrients sequestered in brush and weeds, enabling the reestablishment of grassy species. Portable electric fencing with solar energizers is used to control the goats' foraging area.

4. Converting Brush Land to Oak Woodland

Brush frequently occurs on soils that are best suited for growing brush. Exceptions to this are forest soil areas that have been burned, and have come back as brush. Brushland soils are sloping to very steep loams and are stony or rocky. These soils are usually shallow to bedrock, and available water capacity is low or very low. Vegetation is generally chaparral, which includes such species as chamise, Lemmon ceanothus, buckbrush, toyon, poison-oak, whiteleaf manzanita, and western mountain mahogany. There are few trees occurring on the sites, such as interior live oak and gray pine. At least 80 percent of the surface cover is woody vegetation.

Conversion from brushland to oak woodland entails a thorough investigation of the site. Soil depth, type, aspect, and exposure will all determine the success or failure of an attempted conversion. With few exceptions, most of the brushy sites are naturally occurring, and represent the native vegetative community.

Natural regeneration of oak species is very difficult to accomplish. A conversion from brush to oak woodland should begin with a thorough investigation of the capability of the site to support oak trees. The second, or next step, should be to secure a reliable source of oak seedlings; and the third step should be to develop a planting plan. A realistic cost estimate should be the fourth step. All this should be accomplished before the existing brush cover is removed.

VII. SOILS

As identified on Map #4, a large portion of the western half of the watershed is composed of Chaix-Corbett-Kanaka granitic soil, a granitic soil association, which can be highly susceptible to erosion. Fuels management activities located on unstable soils or on slopes in excess of 40% can stimulate erosion processes or exacerbate existing erosion problems; therefore, prior to any fuels management activities, all soil types within any future project area will be identified and evaluated to determine the erosion hazard. Projects will be designed to prevent or minimize erosion by reducing soil disturbance, maintaining vegetation where appropriate, avoiding steep and unstable slopes if possible, incorporating the use of grass seed or other fire resistant vegetation as a means to provide soil stabilization. The locations of major soil types have been illustrated on Map #4; however, more detailed soils mapping information should be examined once project boundaries have been established.

High intensity wildfire also damages soil by incinerating roots and the humus layer (organic portion of soils) that hold soils together and provides energy dissipation. In addition, the loss of large areas of vegetation can reduce evapotranspiration and increase peak flow, which can result in augmented erosion potential, adversely affecting watershed resources. Many life forms, including invertebrates of phylum Arthropoda that are essential for cycling plant material and fixing atmospheric gases, are unknowingly destroyed. These invertebrates eventually re-establish their populations, but time is lost in maintaining and building up the soils. Over time, continual burning will result in soil depletion, much the same as continual plowing and crop harvesting will deplete the soil of mineral nutrients and negatively affect the soil structure.

Low intensity prescribed fires in light to medium fuels seldom produce enough heat to significantly damage soil or increase the erosion potential within a given watershed. The chemical and physical properties of soil change dramatically after a high intensity fire. Loss of organic matter causes the soil structure to deteriorate, and both the water-storing and transmitting properties of soils are reduced. The living tissues of microorganisms and plants can be damaged by fire if the temperatures are above 1200 degrees F (DeBano 1970).

VIII. ROADS FOR ACCESS

Roads are an essential part of any fire and fuels management plan, providing the principal access to the communities, homes and wild places in the watershed. Additionally, roads may offer a defensible space from which firefighters can conduct direct attack on wildfires and also provide strategic locations for roadside fuel breaks. Roadside fuel breaks not only provide defensible space for firefighters, but also a safe escape route for residents in the event of a wildfire.

State Route 299, the major east-west two-lane highway connecting Weaverville and Redding, runs through the northern section of the watershed. State Route 273 is the main north-south corridor road within the urban area of the watershed. The southern area of the watershed can be accessed by Texas Springs Road from the west and intersects Branstetter Lane in the east. Placer Road, a main thoroughfare running southwest to northeast, transverses the watershed.

All roads are important for providing fire protection access. **This plan will not attempt to identify and map all paved or improved roads.** Roads that are vital to future projects will be included in treatment option plans. Following is a list of fire access roads. For details, see Map #5.

TABLE 3 – SHAST WEST FIRE ACCESS ROADS

A. MAJOR THOROUGHFARES
Highway 299
Highway 273
Placer Road

A. MAIN NORTH-SOUTH ROADS
Swasey Drive

B. MAIN EAST-WEST ROADS
Texas Springs Road / Branstetter Lane

C. OTHER ROADS
Rock Creek Road
Iron Mountain Road
Middle Creek Road
Victoria Drive
Lower Springs Road
Buenaventura Boulevard
Montgomery Ranch Road
Mountain Shadows Drive
Muletown Road

IX. BIOMASS ANALYSIS

For thousands of years, people have been taking advantage of the earth's vegetation, also called biomass, to meet their energy needs (www.epa.gov, 2002). Technologies for using biomass continue to improve and today biomass fuels can be converted into alternative fuels (biofuels), such as ethanol, methanol, biodiesel, and as boiler fuel for use in industrial heating and power generation.

When used for generating electricity, biomass is typically burned to transform water into steam, which is used to a drive a turbine and attached generator (www.epa.gov, 2002). Although a majority of the biomass market is associated with energy production, biomass offers a wide verity of uses such as fiber-reinforced composites, fiber-filled thermoplastics, high performance fiberboard, cement board, mulch for landscaping and soil amenities, smoke chips for curing and flavoring meat and bio-oils which are used as asphalt additives or adhesives. Potential markets continue to be explored and developed by the private sector, and the federal government has also demonstrated interest in the biomass industry. On August 12, 1999, Executive Order 13134 stimulated the creation and early adoption of technologies needed to make biobased products and bioenergy cost-competitive in the large national and international markets (www.bioproducts-bioenergy.gov, 1999).

The utilization and development of biomass technology offers many economic and socioeconomic benefits. One of the most widely acknowledged benefits is the development and utilization of biofuels as a means to reduce the world's dependency on

non-renewable fossil fuels. Presently, a majority of the electricity in the U.S. is generated by burning fossil fuels such as coal, natural gas, and oil. On the local level, the development of biotechnology also offers both economic and socioeconomic benefits.

Implementing fuels reduction projects identified in the plan will provide additional employment opportunities for the local economy. This will be accomplished by increasing the number of people trained in the analysis and removal of excess vegetation. The resulting demand will open opportunities for small businesses investing in equipment to process the biomass and marketing the biomass for the purpose of creating energy. The presence of a wood fired electric generation plant approximately 15 miles away makes this use of the biomass highly feasible. A pilot project in the Middle Creek watershed is designed to show the feasibility of creating a shaded fuel break using mechanical treatment. The multiplier effect of this project will be realized when the fuel reduction projects identified by this study are initiated, and the success of the projects is exported to other locales. The focus of each fuels reduction project will be to maximize biomass utilization. A fuels reduction project in this area typically removes 25 to 50+ tons per acre, depending on the site.

The potential for biomass production within the Shasta West Watershed is good given that the watershed contains a substantial amount of raw material. The closest wood-fired power plant purchasing wood on the open market is in Anderson, California approximately 5 to 15 road miles from the reaches of the watershed. This is a 50-megawatt wood-fired power plant, Wheelabrator Shasta Energy, which utilizes one hundred semi truckloads (~1,400 bone dry tons) of biomass each day, seven days/week, to produce electricity (Jolley 2002). An additional wood-fired power plant is located approximately 3 -13 miles from the watershed's boundaries at the Sierra Pacific Facility in Anderson, California, however this plant does not currently purchase wood on the open market.

The feasibility of any biomass operation depends on the market price of biomass, (also commonly called hogged fuel or hog fuel if it is processed through a hammer hog,) the density or amount of fuel on the ground, and transportation costs. Processing can include harvesting and chipping or hogging and costs are directly correlated with the species, age, size and density of the vegetation being processed as well as the topography of the area. The transportation cost from the project area to the nearest wood fired power plant is directly related to the size of the vehicle, time needed for loading biomass, the road bed system and distance to the plant.

The price a power plant is willing to pay for a ton of biomass vs. the processing and transportation determines the economic feasibility of an operation. However, the value of fuel reduction to the landowner should be included in this calculation to determine the true feasibility of a biomass operation.

Harvesting is usually accomplished with an excavator and/or a bulldozer tractor, which is utilized to remove and pile the brush. Processing can be accomplished with a hammer hog, tub grinder, drum chipper or some other type of industrial type chipper fed by the excavator or other mechanical means.

Biomass Collection in Action

Pursuant to the California Forest Practice Rules, if biomass operations involve the harvest of commercial species, the project requires a permit issued by CDF. Biomass operations not involving the harvest of commercial species are not subject to the California Forest Practice Rules, but may require county permits or other agency review depending on the physical characteristics of the project area. A Registered Professional Forester should be involved prior to commencement of any biomass operation in order to determine what permits might be required and to estimate the cost and timing of obtaining the permits.

Although the biofuels industry is the most developed biomass market in northern California, other markets are currently in the developmental stage and may become a commercially viable option for biomass products in the future. These markets are far from becoming a significant force in the market place, but may provide alternative utilization methods and future marketing opportunities.

X. POTENTIAL FUNDING SOURCES

The following table is a list of cost share programs provided by the University of California, Cooperative Extension Service (UCCE).

TABLE 4 – FUNDING SOURCES AND COST SHARE PROGRAMS

Program	Goals	Services	Will Fund	Agency	Who	Limitations
Emergency Watershed Protection	Helps safeguard people and property following natural disasters.	Technical and financial assistance	Up to 75%	NRCS	Public agencies, non-profits, community groups	25% cost share. Must obtain necessary permits
Environmental Quality Incentives Program	To address significant natural resource needs and objectives	Cost sharing, technical and educational assistance	Up to 75% set by local working group	NRCS, FSA	Agricultural producers having significant natural resource needs	Approved practices up to $10,000 per producer per year. Must have Conservation Plan approved by RCD.
Forest Stewardship Program	Assist California communities to more actively manage their watershed resources, to keep forests and associated resources productive and healthy	Technical, educational and financial assistance	Cost share up to $50,000. 100% match is required.	CDF	RCDs, RC&Ds, special districts, Indian tribes, and community non-profit organizations.	Projects that involves activities that may lead to changes in the environment are required to comply with CEQA. Projects must be on NIPF land & address one of the major categories: pre-fire fuels mgmt, forest &woodland health, water quality, or wildlife & fisheries habitat.
Hazard Mitigation Grant Program	Hazard mitigation to reduce risk from future disasters	Cost share	Up to 75%	FEMA	Agencies, governments, non-profits, tribes	Federal Disaster Areas
Vegetation Management Program	To provide incentives for using fire as a tool to control unwanted brush, and other vegetation, which creates wildfire hazards.	Covers liability, conducts prescribed burn	Up to 90% cost share	CDF	Landowners, individual or group	Agreement to sign, plan required
California Forest Improvement Program	Forestry, watershed and riparian protection and enhancement, and post fire rehabilitation.	Reforestation, site prep, land conservation, and fish & wildlife habitat improvements	75% up to $30,000 per contract, rehab after natural disaster up to 90%	CDF	Landowners	Plan (can be cost shared) required, 20-50,000 acres of forestland

Additional funding sources include:

- **California Department of Conservation**, RCD Grant Assistance Program
- **U. S.D.A. - Forest Service,** Forest Service Community and Private Land Fire Assistance Grant Program
- **Shasta County Regional Advisory Committee**, U.S.D.A. - Forest Service Title II Funds, Secure Rural Schools and Community Self-Determination Act of 2000
- **California Fire Safe Council** (for the Bureau of Land Management), Community-Based Wildfire Prevention Program

XI. FUEL BREAK MAINTENANCE FUNDING

Since grant funds are often obtained just to construct the fuel break, maintenance efforts are often left to the landowner. Unfortunately, some landowners do not have the physical or financial means to do maintenance. If a fuel break is not properly maintained in its entirety, it will not provide adequate fire protection in the long run. Therefore, in some situations it is often best for watershed groups and other conservation organizations to seek funding for maintenance as a means to better ensure fire protection for a given area. The Community Protection Plan was developed as a result of the USDA Forest Service National Fire Plan. This plan provides grant funding for fuel reduction projects on private lands. In addition, many of the programs listed in Table 3 above also provide funding opportunities for fuels reduction and maintenance.

Future legislation may also provide funding for fuels reduction projects. California Assembly Bill 1983 was introduced by Assembly Member Dickerson on February 14, 2002. The bill proposed a **California Fuel Hazard Reduction Act** to be administered by the California Department of Forestry and Fire Protection (CDF), in consultation with the Department of Food and Agriculture, to encourage the development of wildland fuel reduction practices. The bill would have established the Fuel Hazard Reduction Fund in the State Treasury to fund the program, with the CDF authorized to spend up to 5% of the fund balance for program administration and wildfire cost collection. The bill would have authorized the allocation of up to 10% of the fund balance to agencies and institutions each fiscal year for fuel management research purposes. In addition, the bill would have established a cost-share assistance program and would permit the director to fund up to 90% of the cost to complete an eligible wildland fuel reduction project. This bill would have established both the procedure by which applicants may apply for assistance and the process used by the director to grant funds. The full text of the bill can be found at www.leginfo.ca.gov. The bill failed to pass the legislature, however a similar bill will likely be reintroduced at the next legislative session.

In addition, many private sector programs are available. Information on private sector funding can be found at the following Internet sites:

www.fdncenter.org
www.ice.ucdavis.edu/
www.tpl.org/tpl/about/
www.ceres.ca.gov/foreststeward/funding.html
www.teleport.com/~rivernet/general.htm
www.ufei.calpoly.edu/data/news/grants.html

Funding programs can assist in the development of shaded fuel breaks, defensible space around structures, roadside fuel reduction, and community fire safe projects.

XII. STRATEGIC FUEL MANAGEMENT PLAN ACTION ITEMS

INTRODUCTION:
Action items described in this plan have been proposed by the Shasta West Fuels TAC. All action items are considered an integral part of the plan to manage the fuels in the Shasta West Watershed.

A. CONSTRUCT SHADED FUEL BREAKS:
Population concentrations, road densities, fuel conditions, and resources at risk vary throughout the Shasta West Watershed. The TAC divided the watershed into nine Strategic Planning Areas in an effort to devise logical fuel management strategies. Area boundaries were determined by topography, roads, and major powerlines (See Map #6).

A priority list of fuel reduction and maintenance projects was developed by the TAC, and taken to the community for discussion. Factors considered in developing this list include:

- Fire history for the area, both lightning-caused and human-caused fires;
- Heavy fuel loading conditions with closed canopies;
- Assets at risk;
- Common wind directions and speed;
- Roadsides overgrown with vegetation;
- Major topographical features important to fire control and weather patterns which influence fire behavior; and
- Road access for fire fighters;

Locations of the proposed fuel breaks are a combination of neighborhood protection and compartmentalizing the fuels in the watershed (See Map # 6). New fuel breaks should be constructed following the priorities set below, as funding becomes available. The following are specific projects for each Strategic Planning Area ranked by the TAC and the Community as First, High, Medium or Lower Priority:

- **Area #1** - Rock Creek / Keswick – Includes entire Rock Creek subwatershed - northern Shasta West Watershed boundary, Sacramento River, ridgeline, Hwy. 299

    - **Roadside fuel break - Rock Creek Road**. Construct approximately 2.5 miles of shaded fuel break 50 feet wide along both sides of Rock Creek Road. This fuel break can be constructed during the summer using the RCD crews and chippers. This will be a multiple landowner project, and will include time to get landowner entry permits. This project involves public land and will be coordinated with BLM. Identified as First Priority for Area #1.
    - **Roadside fuel break – Miners Gulch Road**. Construct approximately 2,500 feet, 50 feet wide shaded fuel break on both sides of Miners Gulch Road. Identified as High Priority for Area #1.

- **Complete southern boundary fuel break**. Construct approximately 2 mile long shaded fuel break 300 feet wide along the ridge between Rock Creek and Middle Creek which includes the area near Shasta Mountain Road east to Iron Mountain Road. This land is presently public land, but is reportedly up for trade. It would be prudent to wait on this construction until the land trade is completed. Identified as High Priority for Area #1.
- **Roadside fuel break - Keswick Dam Road from Iron Mountain Road to Sacramento River.** Construct approximately 4,400 feet long, 100 feet wide, shaded fuel break on either side Keswick Dam Road. Identified as Medium Priority for Area #1.
- **Fuel break along power line (coordinate with erosion project).** Widen cleared area to 100 feet beyond the power line. Project length is approximately 2.5 miles and is basically from Iron Mountain Road to Whiskeytown NRA. Landowner entry permits will be a major concern with this project, which involves both public and private land. Identified as Lower Priority for Area #1.

- **Area #2** - Middle Creek Corridor – ridgeline, Sacramento River, WAPA power line, Hwy. 299

  - **Roadside Fuel break - Old Middle Creek / Stage Road**. Construct approximately 2,100 feet, 50 feet wide shaded fuel break along both sides of this historic road, which is located basically from the transfer station east to Iron Mountain Road. Identified as First Priority for Area #2.
  - **Roadside fuel break - Hwy. 299 corridor, CalTrans/BLM/CDF**. Construct a shaded fuel break approximately 4 miles long, an average 50 feet wide on both sides of Hwy. 299, or 100 feet wide on one side of the highway starting at Salt Creek and running west to Whiskeytown NRA. This shaded fuel break has been planned for three years. The key to constructing this fuel break is the coordination between all agencies involved. Identified as High Priority for Area #2.
  - **Fuel reduction – small triangle, Salt Creek Rd., WAPA power lines, Hwy. 299**. Possible biomass reduction project, or prescribed burn to create an open space. Identified as High Priority for Area #2.
  - **Fuel Treatment Demo Area – Hwy. 299 / Station 58, CDF, BLM, and WSRCD**. Construct a planned shaded fuel break demonstration area. All aspects of fuel reduction are planned to be demonstrated on this site. It will need the coordination of the agencies and district. Identified as High Priority for Area #2.
  - **Project F.U.E.L. – fuel break from Hwy. 299 to the Sacramento River**. This project is part of Project F.U.E.L. through a grant from USDA Forest Service to WSRCD and is scheduled to be biomassed in 2004. This shaded fuel break is planned to be approximately 6,300 feet long and 300 feet wide. Identified as High Priority for Area #2.

- **Area #3** - Upper Middle Creek – 299, Swasey Drive, ridgeline, western Shasta West Watershed boundary

    - **Fill-in and Maintenance of upper Muletown Road fuel break project - Red Bluff Road to Falcon View Road.** Part of this concern is being addressed by WSRCD the fall of 2003 through a grant from the National Park Service. The remaining maintenance needs to be addressed. Identified as First Priority for Area #3.
    - **Roadside fuel break – Swasey Drive**. This shaded fuel break is presently in the planning stages, and is scheduled to be an approximately 10,800 feet long and 100 feet wide on either side of the road. Constructed is anticipated to begin in early 2004 through a grant from the National Park Service. Identified as High Priority for Area #3.
    - **Maintenance of National Park Service fuel break - Shasta Ridgeline.** This project is located along the watershed divide between the Shasta West Watershed and the Upper Clear Creek Watershed. The current shaded fuel break begins at Highway 299 and runs south approximately 3.5 miles. Maintenance is needed to retain the protection that the fuel break offers. Identified as High Priority for Area #3.

- **Area #4** - Victoria / Highland Way Triangle – Hwy. 299, Lower Springs Rd., Swasey Drive

    - **Roadside fuel break – Lower Springs Road**. This shaded fuel break project is presently in the planning stages. This shaded fuel break is planned to be approximately 9,961 feet long and 100 feet wide on either side of the road. The project is scheduled to be constructed in early 2004 through a grant from the National Park Service. Identified as First Priority for Area #4.

- **Area #5** - Prospect / Sugarloaf – Hwy. 299, WAPA power line, Placer Rd. Swasey Drive, Lower Springs Rd.

    - **Roadside fuel break - Swasey Drive**. This shaded fuel break is presently in the planning stages, and is scheduled to be constructed in early 2004 through a grant from the National Park Service. The fuel break is planned to be approximately 4,500 feet long, 300 feet wide, and will be constructed from the archery range north to Hwy. 299. Identified as First Priority for Area #5.
    - **East-West fuel break - South end of top 1/3 of Strategic Planning Area**. Construct approximately 1.25 mile long, 300 feet wide shaded fuel break on the tops of ridges basically from Lower Springs Road to Skywalker Drive. BLM is a major landowner in the area, so any fuel break planning must be coordinated with them. Identified as High Priority for Area #5.
    - **East-West fuel break - Sugar Loaf area**. Construct approximately 0.75 miles long, 300 feet wide, shaded fuel break on the ridge top, and connect into the E-W fuel break described above. BLM is a major landowner in the area, so any fuel break planning must be coordinated with them. Identified as Medium Priority for Area #5.

- **Area #6** - Swasey Southwest – ridgeline, Swasey Drive, Placer Road, western watershed boundary

    - **Roadside fuel break – Sans Souci area.** Construct approximately 4,000 feet, 100 feet wide shaded fuel break on either side of Sans Souci Drive, La Paloma Road and Horizon Hills Road. This fuel break project can be constructed during the summer using the RCD chippers. This will be a multiple landowner project, and will include time to get landowner entry permits. Identified as First Priority for Area #6.
    - **Fuel break – BLM tributary fuel break to Mule Mountain fuel break.** Construct approximately 7,500 feet long, 150 feet wide shaded fuel break to tie in the fuel breaks already on Mule Mountain with the Shooting Range fuel break described above. Identified as High Priority for Area #6.
    - **Fuel break – Shooting Range**. This shaded fuel break, being planned by BLM, is intended to be approximately 7,000 feet long and 300 feet wide from the shooting range east to Swasey Drive. The project is currently in the environmental documentation process. Identified as High Priority for Area #6.
    - **Fuel break – Secluded Valley perimeter**. This shaded fuel break is currently under construction by WSRCD and CDF inmate crews. The fuel break was originally designed as a perimeter of defensible space around the entire subdivision. Since the terrain throughout much of the break sloped uphill away from the homes, topography was considered on an individual-parcel basis to "field fit" the fuelbreak and offer maximum protection to residents. The finished fuel break will vary in width to a maximum of 150 feet and will extend approximately 1.5 miles with several spur breaks in key locations for added defensible space. The project is on schedule to be completed by the end of January '04. Identified as High Priority for Area #6.

- **Area #7** - Tadpole / Olney – Placer Road, WAPA power line, southern Shasta West watershed boundary

    - **Shaded fuel break – Olney Creek Subdivision.** Construct approximately 5,800 feet long, 150 feet wide shaded fuel break around perimeter of Olney Creek Subdivision. Identified as First Priority for Area #7.

- **Area #8** - Redding Westside – Sacramento River, Hwy. 273, southern Shasta West Watershed boundary, WAPA power line

    - **Roadside fuel break – Buenaventura Blvd.** Construct approximately 11,800 feet long, 100 feet wide shaded fuel break along either side of Buenaventura Blvd. from Placer Road to Hwy. 273. Identified as First Priority for Area #8.
    - **Fuel break – Kenyon Drive to Powerline Road**. Construct approximately 3,520 feet, up to 300 feet wide shaded fuel break from end of pavement of Kenyon Drive west to Powerline Road. This should effectively

compartmentalize fuels on the east side of the watershed. It may also serve as an escape route in case of an emergency evacuation. Identified as High Priority for Area #8.

- **Fuel break - WAPA Powerline east to Deiselhorst Bridge.** Construct approximately 9,662 feet long, 100 feet wide shaded fuel break along south side of Southern Pacific right-of-way. Identified as High Priority for Area #8.
- **Fuel reduction**. Perform fuel reduction activities at the Record Shooting Range off of Record Lane on City and County property west of Mary Lake. This area of dense fuels with frequent potential ignition sources should be considered for fuel reduction activities such as a perimeter fuel break or biomass reduction project. Identified as Lower Priority for Area #8.

- **Area #9** - Sacramento River, southern Shasta West Watershed boundary, Hwy 273

  - No specific fuel management projects identified.

B. COMMUNITY EVACUATION PLAN

Develop community evacuation plans for the rural communities in the Shasta West Watershed. These plans will include people, pets, horses, and other livestock. The process should include several community meetings to get input from local residents. Local areas will be designated as fire safe areas for residents to gather in case of a wildfire.

C. FIRE SAFETY INSPECTIONS

The TAC, agencies, and the WSRCD will seek funding for fire safe inspectors to go door-to-door to educate homeowners about fire safety. Ideally, home inspections would be conducted in the spring for at least two years. Home fire safety inspections will be coordinated with local Volunteer Fire Departments, the City of Redding, and Shasta County Fire Department. These inspectors would also have the capability of helping residents understand how to construct defensible space around their homes. CDF will also work with residents to inform them how to safely defend their property during a wildfire, through the existing Sheltering In Place Program.

D. FIRE REPELLENT PRODUCT EVALUATION

Investigate and evaluate fire repellent products, such as foams and gels, that homeowners could apply themselves. Demonstrate products to the community if found to be desirable.

E. NEIGHBORHOOD COORDINATOR PROGRAM

Establish a Neighborhood Coordinator Program through out the watershed. The role of a coordinator is to get the word out in the event of an emergency, and to be the neighborhood contact for fuel reduction and education activities. In the event of a disaster, they would assist firefighters and emergency workers in determining which residents are still in the neighborhood.

F. HAZARD AND FUEL REDUCTION EDUCATION

Assemble and distribute hazard, fuel reduction, fuel treatment and maintenance education materials to landowners, developers, and other stakeholders in the watershed. Efforts will be in collaboration with local, county, state and federal agency education activities. Various methods of media will be investigated including large visual (road signs), print, radio, video, and live presentations.

G. NEIGHBORHOOD FUEL REDUCTION ACTIVITIES

Many residents in the watershed have expressed concern for the amount of fuel build up in their neighborhoods and around their homes. WSRCD will seek funding to encourage and coordinate neighborhood fuel reduction activities, such as Neighborhood Cleanup Days. Cleanup Days offer the opportunity for residents to dispose of the woody material trimmed from their yards without burning it, thus reducing air pollution in the Redding Basin. Cleanup Days would be scheduled once or twice a year, and would consist of stationing a chipper and WSRCD staff at a central location to process materials delivered by residents.

H. ROAD STATUS EVALUATION

Many roads within the watershed are inadequate for firefighting equipment and may be hazardous for use as evacuation routes. WSRCD will seek funding to identify existing and possible secondary emergency road access and evaluate steps to make areas more accessible. WSRCD will work with landowners to seek funding to determine private bridge capacities, bring private roads and bridges up to the safety standards required for fire engine access, and to develop secondary emergency road access when possible.

I. GENERATE ACCURATE FUELS DATA

CDF FRAP surface fuel data is commonly used to determine fire hazards and fire behavior. As described by CDF on its FRAP website, "FRAP develops surface fuels data by translating vegetation data from a variety of sources into stylized fuel characteristics models used to predict fire behavior. Each surface fuel model describes a set of fire behavior outputs (flame length, rate of spread, etc.).

"Surface fuel models are used to predict fire behavior, provide an input to fire behavior models such as FARSITE, and are an important component of various hazard assessment methodologies.

"The process of converting vegetation data into surface fuels is known as 'cross walking,' which translates information on plant species, crown cover and tree size into 13 standard and 7 custom fire behavior models. The crosswalk process uses other factors, such as watershed boundaries, slope, aspect and elevation, to further refine vegetation/fuel model relationships. Annual fire perimeter data is used to update fuel model characteristics based on 'time since last burned', to account for both initial changes in fuels resulting from fuel consumption by the fire, and for vegetation regrowth." A detailed description of the data and methods can be found at http://frapd.cdf.ca.gov/projects/fire_data.

Through consultation with CDF and ground truthing, existing surface fuel data on the CDF FRAP data site was determined to be inaccurate. WSRCD will seek funding to collect accurate fuels data to be used for predicting future wildfire behavior. Accurate fuel data will allow a fuel model to estimate fire behavior during severe fire hazard conditions when wildfires pose greater control problems and severely impact natural resources.

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APPENDIX & MAPS

APPENDIX

A. Glossary
B. Active Technical Advisory Committee Members
C. Community Fire Safe Fuel Reduction Guidelines

MAPS

1. Fire Hazard Severity Zones
2. Fire History
3. Land Ownership
4. Soils
5. Existing Roads Map
6. Strategic Fuels Reduction Network, Including Proposed Projects

A. GLOSSARY

Chain – A linear unit of measurement equal to 66 feet.

Fire Hazard - The fuel potentially available for burning. Fire hazard takes into consideration such factors as location, quantity, arrangement, and current or potential flammability of the fuel. When considered in combination with fire weather variables, it determines the difficulty of suppression once the fuel is ignited and also signifies the potential threat to human life, property and other assets.

Fire Risk - The probability of a fire starting from natural or human causes.

Fuel Characteristics – Factors that make up fuels such as compactness, loading, horizontal continuity, vertical arrangement, chemical content, size and shape, and moisture content.

Fuel Chemical Content – Substances in the fuels which can either retard or increase the rate of combustion, such as mineral content, resins, oils, wax or pitch.

Fuel Ladder – Fuels which provide vertical continuity between strata. Fire is able to carry from ground, to surface, to crown.

Fuel Moisture Content – The amount of water in a fuel, expressed as a percentage of the ovendry weight of that fuel.

Fuels – Any organic material, living or dead, in the ground, on the ground, or in the air, that will ignite and burn. General fuel groups are grass, brush, timber and slash.

Mechanical Treatment – Using mechanized equipment including but not limited to bulldozers with or without brush rakes, rubber tired skidders, mechanized falling machines, chippers and grinders.

Pile and Burn – Material is cut and piled in open areas to be burned. Burning takes place under permitting environmental conditions.

Prescribed Burning – The burning of forest or range fuels on a specific area under predetermined conditions so that the fire is confined to that area to fulfill silvicultural, wildlife management, sanitary or hazard reduction requirements, or otherwise achieve forestry or range objectives.

Rate of Speed – It is expressed as rate of forward spread of the fire front, usually is expressed as chains per hour.

Shaded Fuel break – A wide strip or block of land on which the vegetation has been modified by reducing the amount of fuel available, rearranging fuels so that they do not carry fire easily, and replacing particularly flammable fuels with others that ignite less easily and burn less intensely.

Surface Fire – A fire that burns surface litter, debris and small vegetation.

Topography – The configuration of the earth's surface, including its relief and the position of its natural and manmade features.

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Acronyms

WSRCD – Western Shasta Resource Conservation District
BLM – Bureau of Land Management
CDFG – California Department of Fish and Game
CDF – California Department of Forestry and Fire Protection
CALTRANS – California Department of Transportation
NRCS – National Resources Conservation Service
RWQCB - Regional Water Quality Control Board

C. COMMUNITY FIRE SAFE FUEL REDUCTION GUIDELINES

FUEL REDUCTION GUIDELINES

A CRITICAL ELEMENT OF THE COMMUNITY FIRE SAFE PROGRAM IS TO REDUCE THE AMOUNT OF FUEL AVAILABLE TO AN UNCONTROLLED VEGETATION FIRE. YOU CAN REDUCE UNWANTED VEGETATION BY APPLYING THESE GUIDELINES TO YOUR PROPERTY AND WORKING TO ACHIEVE FUEL REDUCTION.

RALPH MINNICH
BATTALION CHIEF
FEBRUARY, 1996

ARTWORK BY PATRICK WESTRIP

RHM:Fuel Reduction Guidelines

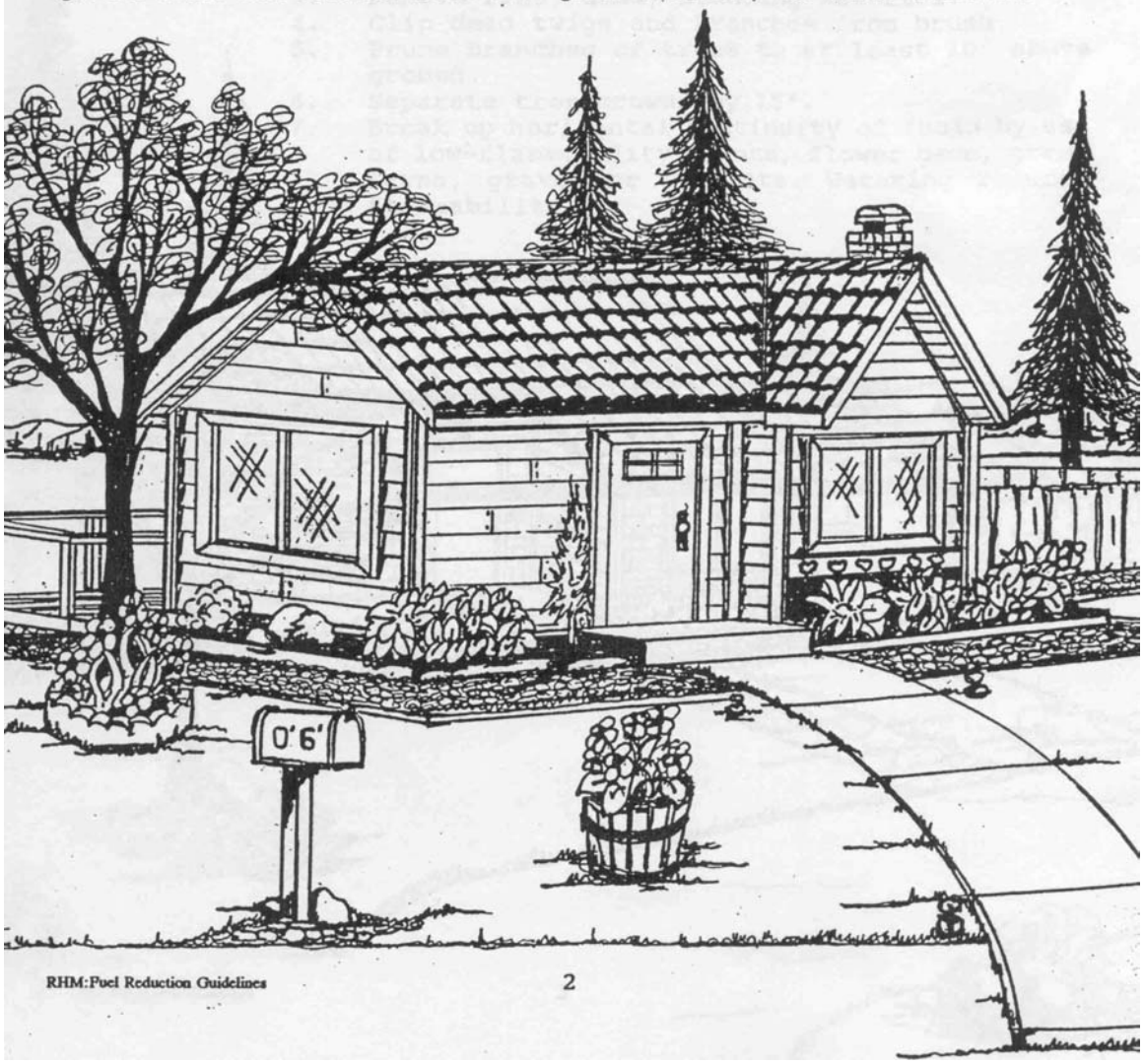
1. The Home Zone 0' to 6'

GOAL: To prevent the spread of fire from the structure to vegetation or from vegetation to the structure.

OBJECTIVE: Remove all fuel sources from this zone. Conifer trees, brush, dry grass, leaves, needles, woodpiles and flammable ornamentals are examples.

Remember to clean leaves and needles from roofs and gutters.

This zone can be landscaped with gravel, concrete or left bare to mineral soil. Replacing vegetation with less-flammable plants, green lawn and flower beds are good choices, if well-watered.



2. The Yard Zone 6' to 30'

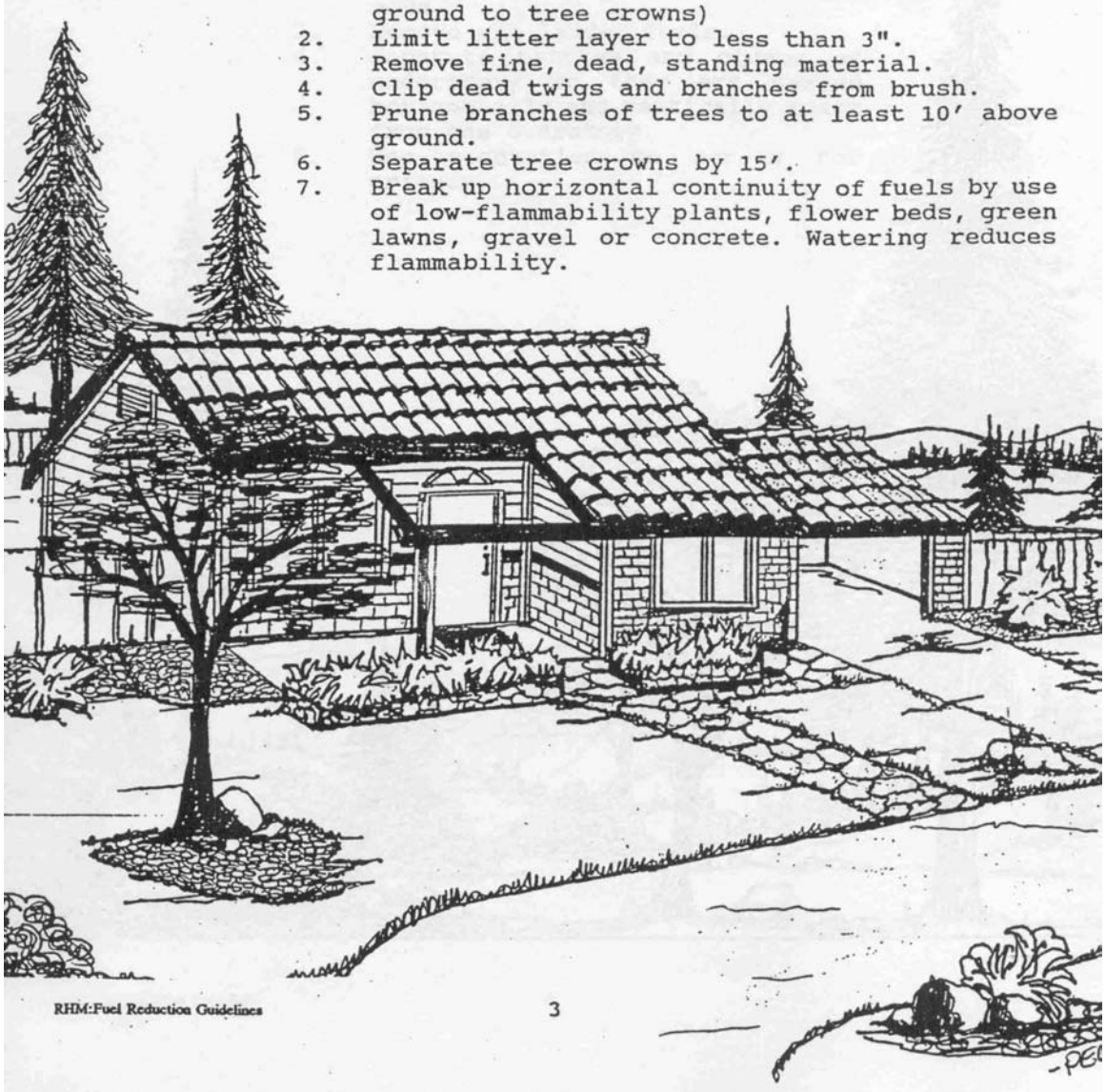
GOAL: To prevent a fire from moving from ground fuels to brush or tree crowns and to slow the rate of fire spread.

> reduced fuels means reduced fire intensity
> reduces potential exposure problems
> preserves overstory vegetation

[This zone should be sufficient for grasslands and is integrated into fuel reduction for brush and timberlands.]

OBJECTIVE:

1. Eliminate fuel ladders (continuous fuel from ground to tree crowns)
2. Limit litter layer to less than 3".
3. Remove fine, dead, standing material.
4. Clip dead twigs and branches from brush.
5. Prune branches of trees to at least 10' above ground.
6. Separate tree crowns by 15'.
7. Break up horizontal continuity of fuels by use of low-flammability plants, flower beds, green lawns, gravel or concrete. Watering reduces flammability.



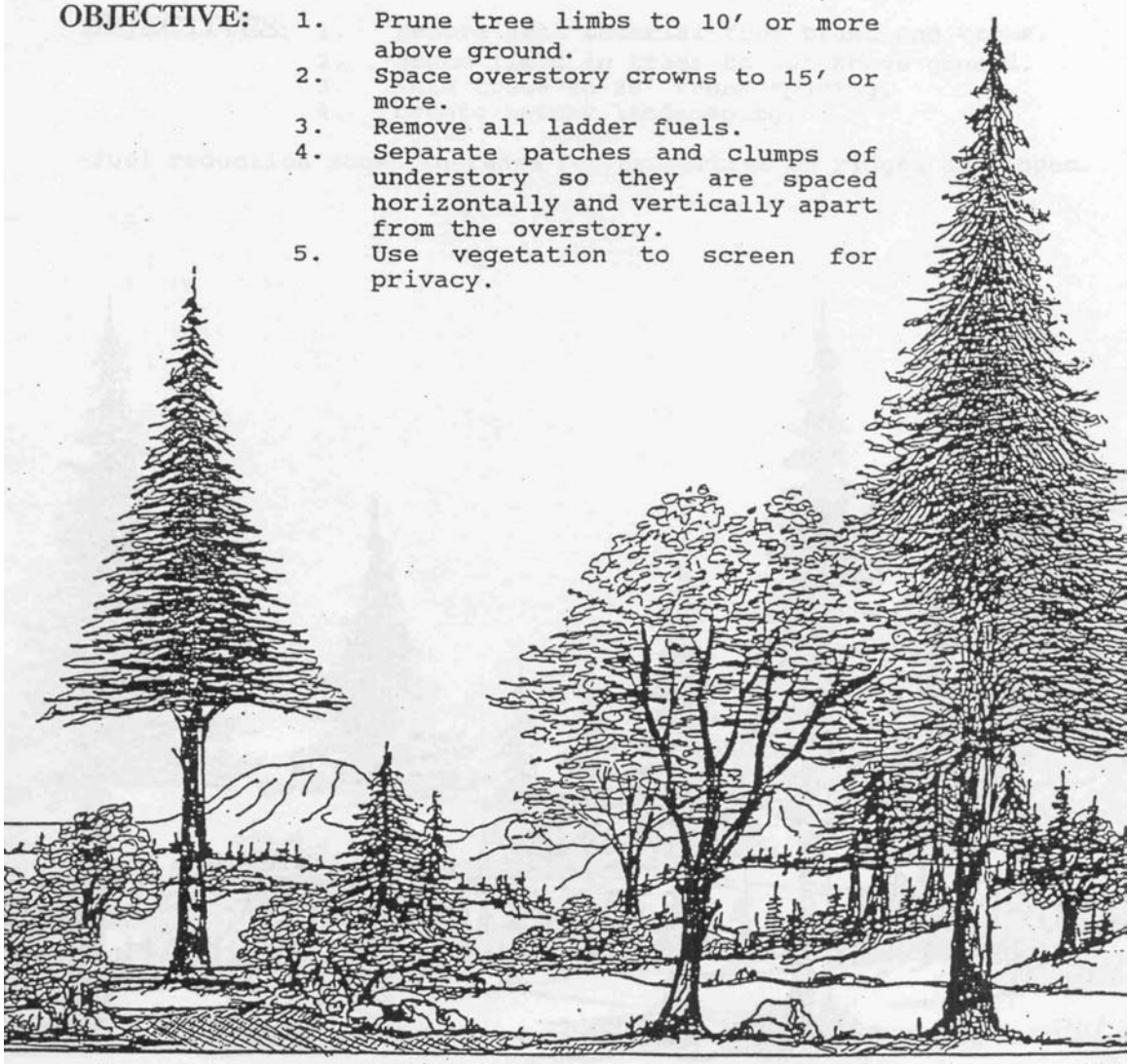
3. The Brush / Screen Zone 30' to 75'

GOAL: To keep a wildland fire on the ground thereby minimizing intense burning and damage to overstory vegetation.

[This is the primary zone for fire suppression. Although 75′ of fuel reduction appears adequate for brushcovered lands, further effort is necessary in timberlands.]

OBJECTIVE:

1. Prune tree limbs to 10′ or more above ground.
2. Space overstory crowns to 15′ or more.
3. Remove all ladder fuels.
4. Separate patches and clumps of understory so they are spaced horizontally and vertically apart from the overstory.
5. Use vegetation to screen for privacy.



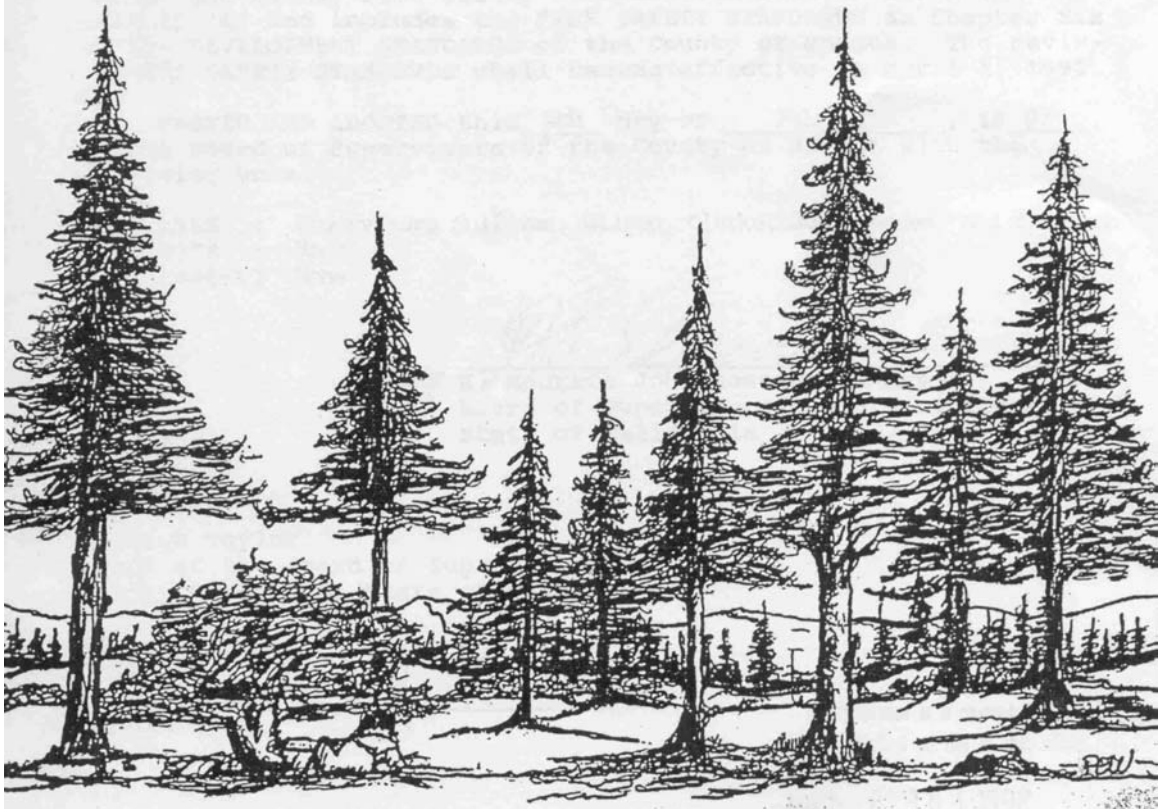
4. Woodland / Forest Zone 75' to 150'*

GOAL: To provide a space in which a fire will "cool down, slow down and stay on the ground" thereby maintaining fire safety in forest communities.

[This zone can provide cover for wildlife. Views within this zone can be enhanced to be more aesthetically pleasing.]

OBJECTIVES:
1. Remove dead material from brush and trees.
2. Prune limbs in trees to 10' above ground.
3. Thin trees to 20' trunk spacing.
4. Create patchy landscaping.

*Fuel reduction zones increase for properties on ridges or slopes.



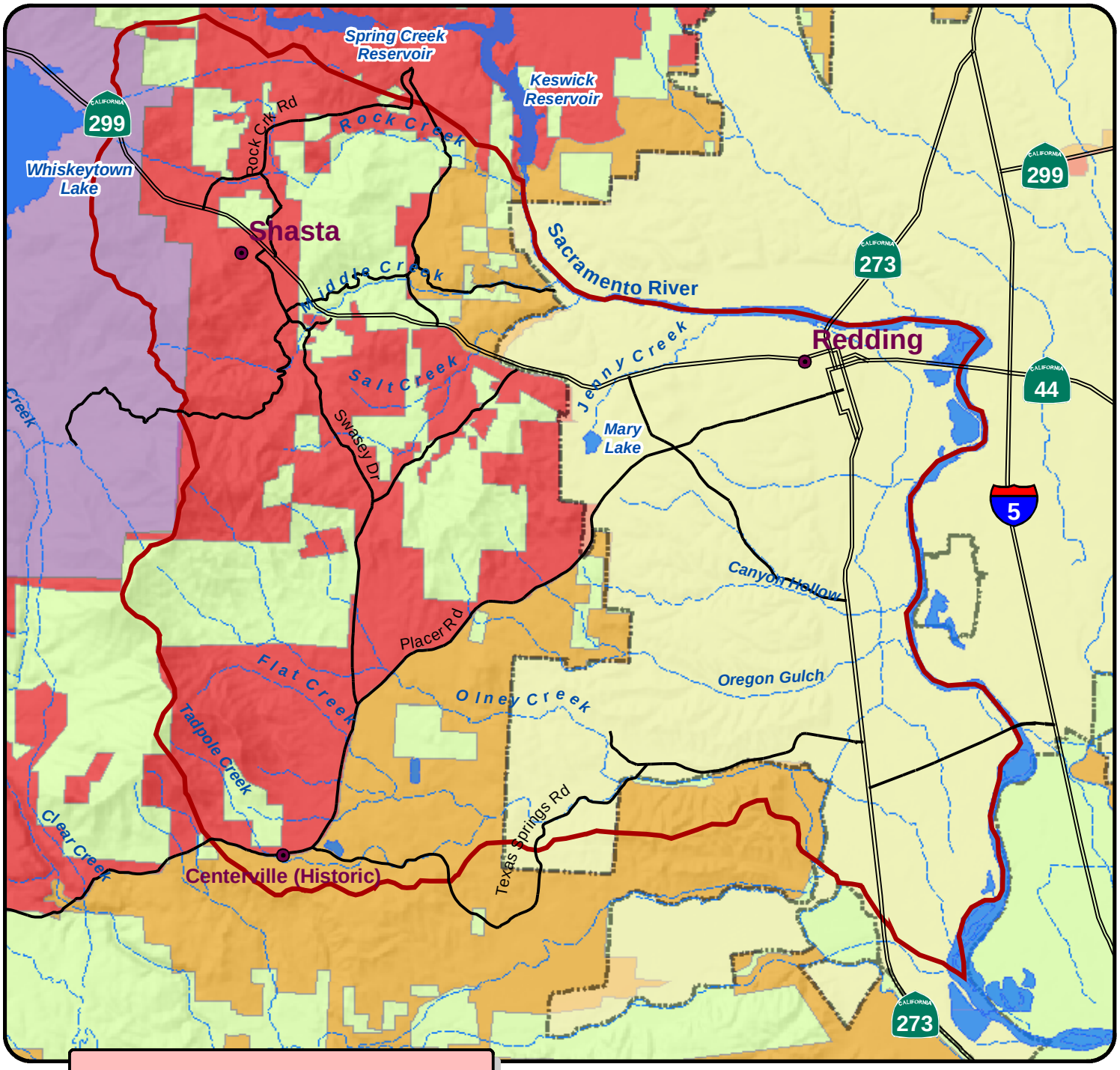
Fire Hazard Severity Zones

Shasta West Watershed

Map 1

Based on fuel loading, slope, fire weather, and other factors as determined by the CA Dept of Forestry & Fire Protection

Western Shasta Resource Conservation District



Legend

- City/Town
- Highway
- Other Major SW Road
- SW Watershed
- Lake
- Creek
- Whiskeytown NRA

Severity

- MODERATE (No Areas in SW)
- HIGH
- VERY HIGH
- Non-State Responsibility Areas
- Redding (Non-State Responsibility)

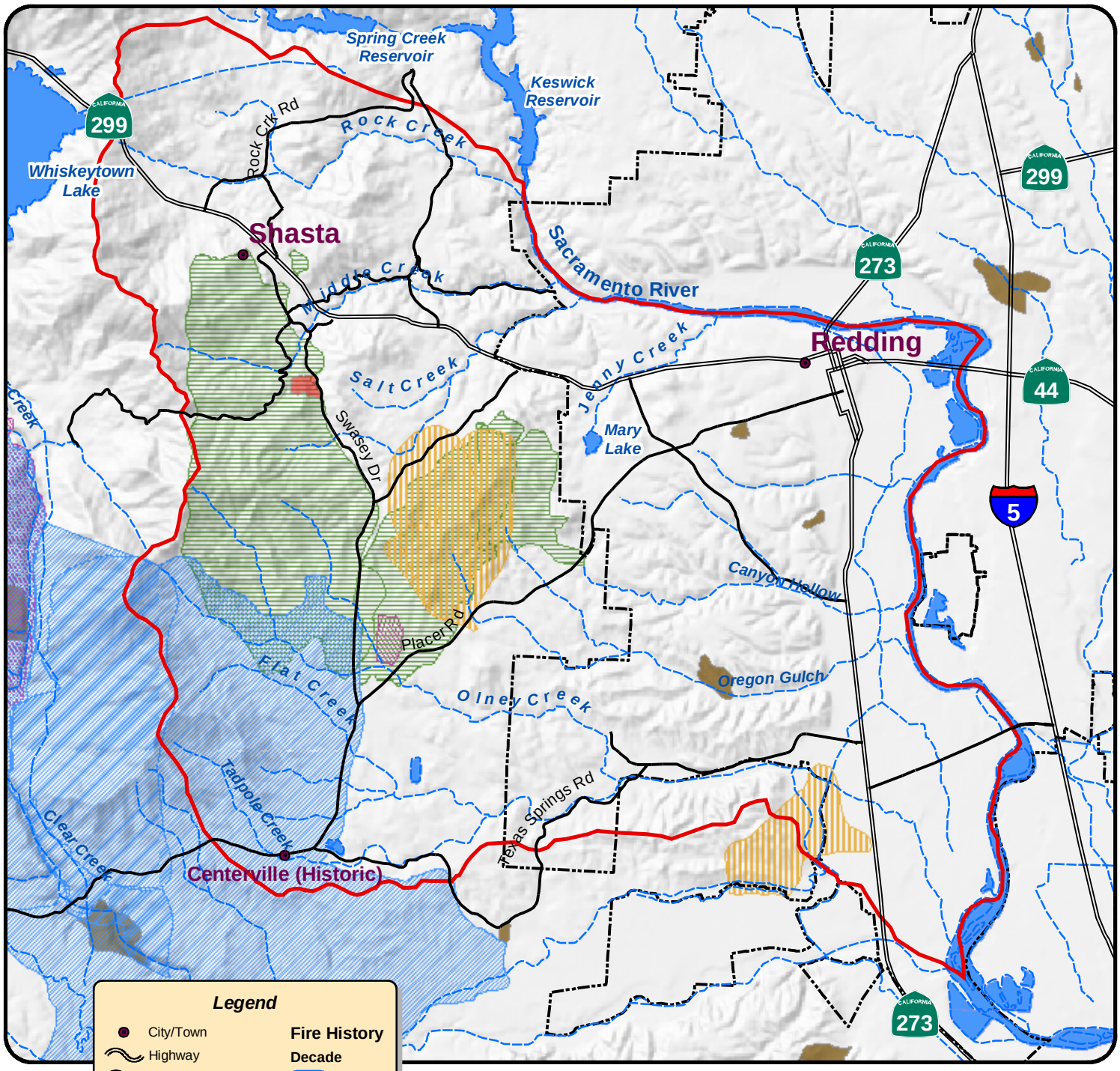
0 1 2 4 Miles

Updated December, 2003
Source: CDF FRAP (1998)
Albers, NAD27
"Other" Roads displayed to WS Boundary only

FIRE HISTORY

SHASTA WEST WATERSHED

WESTERN SHASTA RESOURCE CONSERVATION DISTRICT

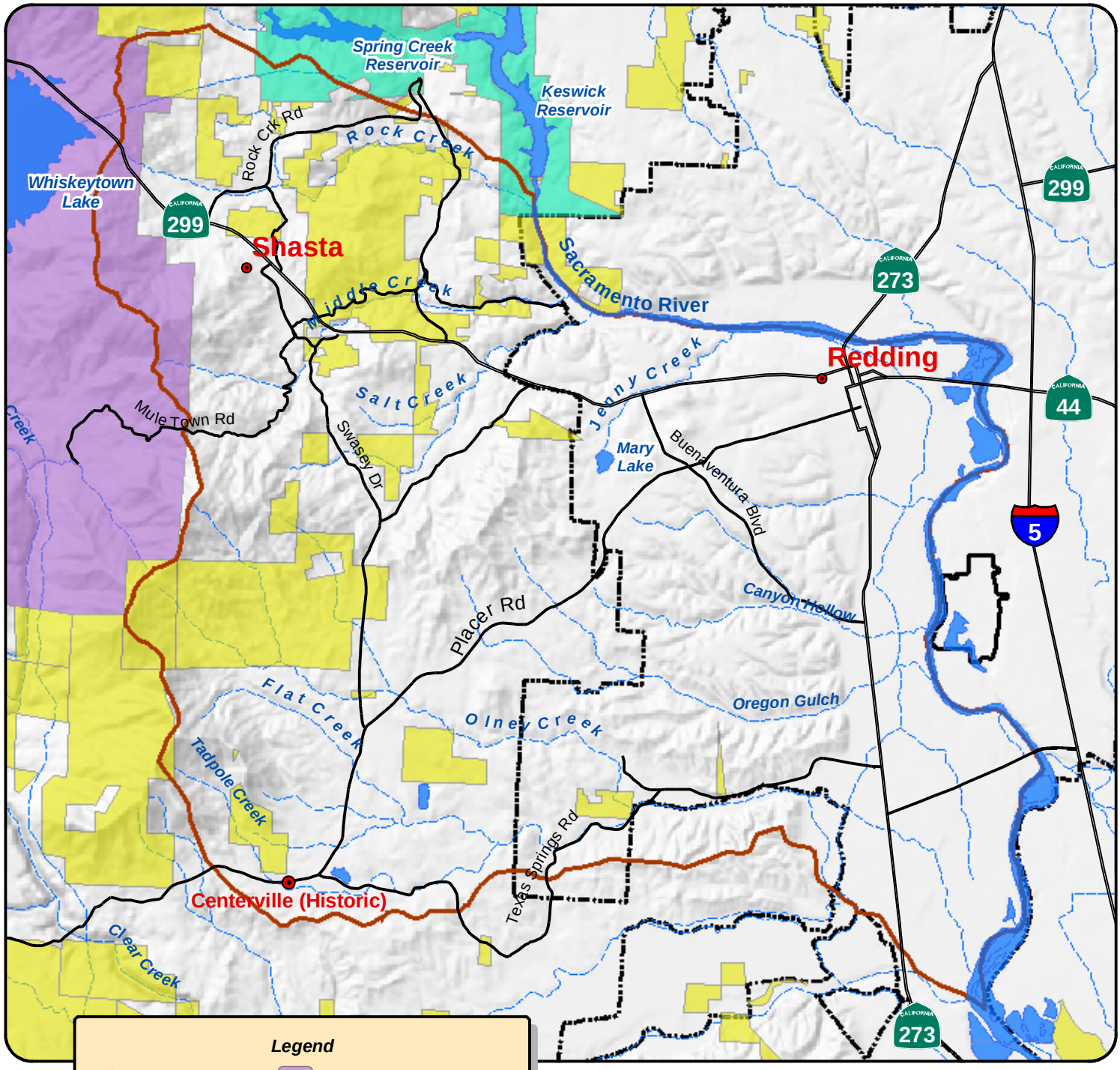


Created August 28, 2003
Source: CDF & USDA FS
Albers, NAD27
"Other" Roads displayed to WS Boundary only

LAND OWNERSHIP

SHASTA WEST WATERSHED

WESTERN SHASTA RESOURCE CONSERVATION DISTRICT



Legend

- City/Town
- Highway
- Other Major SW Road
- Creek
- Lake
- SW Watershed
- Redding City Boundary
- US National Park Service
- US Bureau of Land Management
- US Bureau of Reclamation
- State Land Commission

Uncolored Areas are Private or County/City Property

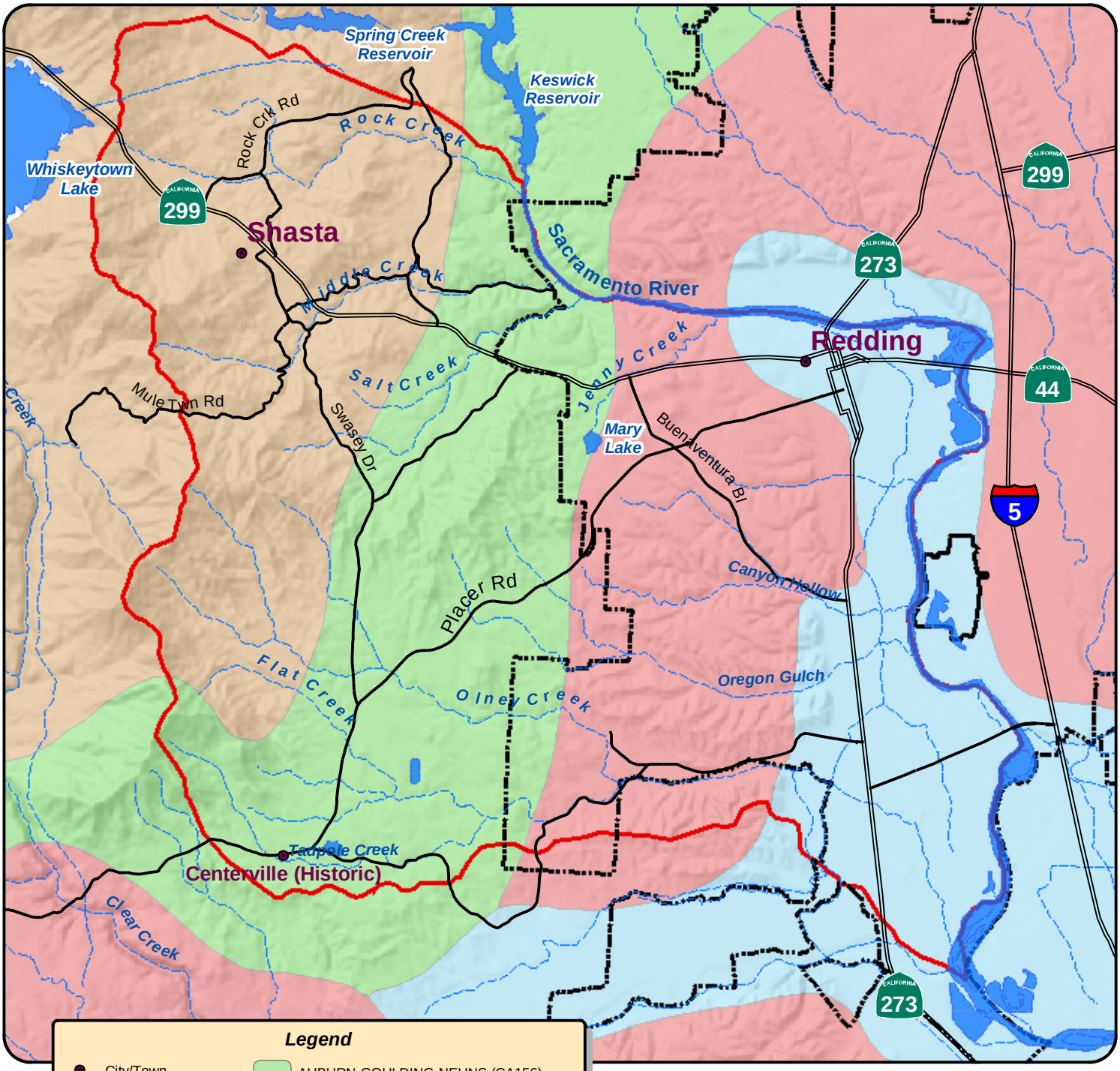
Miles
0 1 2 4

Created September 4, 2003
Source: CASIL
Albers, NAD27
"Other" Roads displayed to WS Boundary only

SOILS

SHASTA WEST WATERSHED

WESTERN SHASTA RESOURCE CONSERVATION DISTRICT

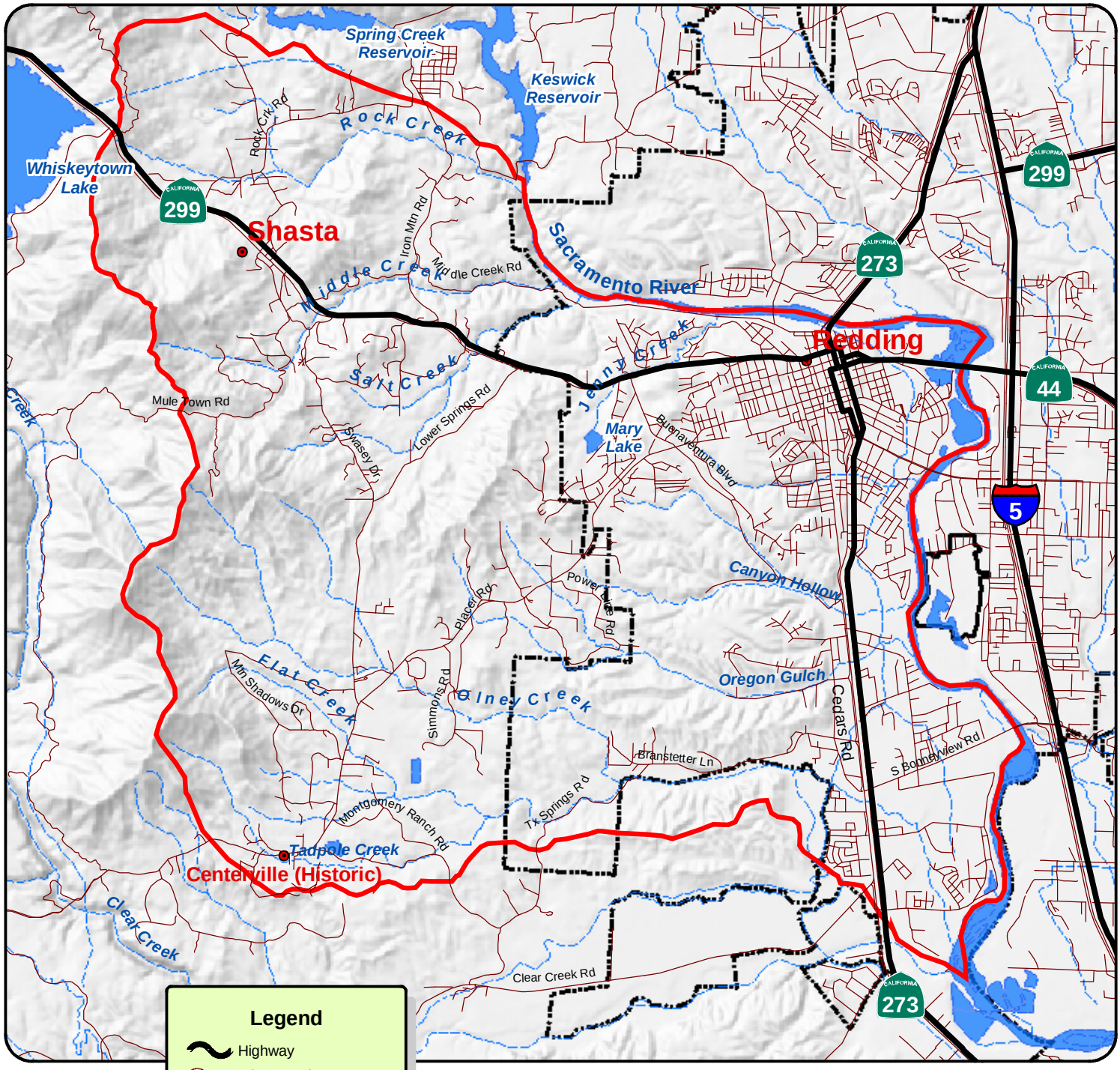


Created August 28, 2003
Source: USDA, NRCS
Albers, NAD27
"Other" Roads displayed to WS Boundary only

Existing Roads

Shasta West Watershed

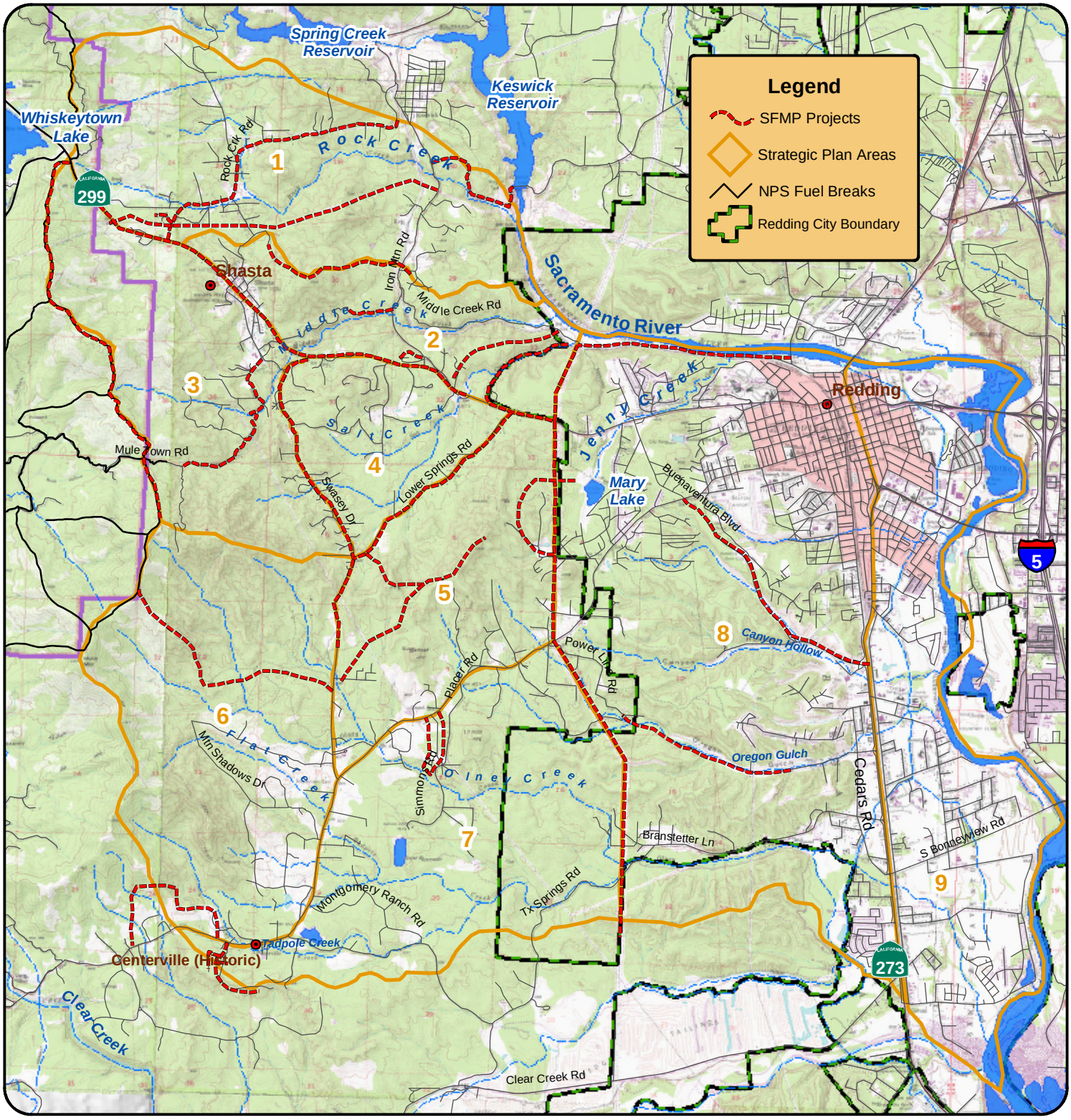
Map 5



Suggested Project Areas

Map 6

Shasta West Watershed



N

0 0.45 0.9 1.8 Miles

Created November 20, 2003
Sources: CASIL, NPS, BLM
Albers, NAD27