COTTONWOOD CREEK WATERSHED STRATEGIC FUELS REDUCTION AND MANAGEMENT PLAN UPDATE 2010

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WESTERN SHASTA RESOURCE CONSERVATION DISTRICT

COUNTY OF SHASTA CALIFORNIA

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COTTONWOOD CREEK WATERSHED
STRATEGIC FUELS REDUCTION
AND MANAGEMENT PLAN UPDATE (2010)

SIGNATURE BLOCK

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COTTONWOOD CREEK WATERSHED STRATEGIC FUELS REDUCTION AND MANAGEMENT PLAN UPDATE (2010)

I. INTRODUCTION

A. THE PLAN

In 2009, Shasta County entered into a consulting services agreement with Western Shasta Resource Conservation District (WSRCD) to update all of the existing strategic fuel management plans in western Shasta County including the 2001 *Cottonwood Creek Watershed Strategic Fuels Reduction and Management Plan* (Plan). The purpose of the update was to meet with the Cottonwood Fire Safe Council, the watershed group, landowners, and agencies to review the existing project list and priorities, move completed projects to a category of maintenance projects, add new projects, identify wildland urban interface areas, conduct risk assesments, and establish a revised list of priorty projects.

The Plan update addresses values at risk, landowner objectives, the types of fuel treatments, the road system, potential funding sources, and fuelbreak locations, which together developed the updated fire safe plan. The recommendations include locating shaded fuelbreaks along key roadways, increasing publicity for the updated fire and community evacuation plan, post the Plan on the Cottonwood Creek Watershed Group and Shasta County Fire Safe Council websites, the Sacramento Watershed Information Model (SWIM), and continue annual neighborhood-based fuel reduction work. Background information from the original Plan was included, as well as revisions based on new information.

The 603,854-acre Cottonwood Creek Watershed planning area **(Map 1)** is located approximately 13 miles south of Redding, California on the west side of the Sacramento River in both Shasta and Tehama Counties (Map 1). It is bordered on the north by the Anderson Creek and Lower Clear Creek watersheds, on the south by Red Bank Creek and Thomes Creek watersheds, on the east by the Sacramento River, and on the west by the USDA Forest Service Yolla Bolly-Middle Eel Wilderness and Shasta Trinity National Forest, and the Trinity County line. The main watercourses within the Cottonwood Creek Watershed are Beegum Creek and the North Fork, Middle Fork (flowing along the Shasta/Tehama County line) and South Fork of Cottonwood Creek, which flow in an easterly direction to the Sacramento River.

Population is concentrated in the eastern portion of the watershed in the communities of Cottonwood with approximately 3293 residents and Lake California with approximately 2760 residents (Sperlings Best Places, www.bestplaces.net, 2009). Smaller communities scattered in both counties include Igo, Ono, Platina, Beegum, Bowman, R-Wildhorse Ranch, Wilcox, and Dibble Creek.

Generally, the climate of the Cottonwood Creek Watershed is characterized by warm, dry summers and cool, wet winters. The average temperature and precipitation vary greatly within the watershed due to elevation ranges from 350-7,000 feet. The average temperature range in July is from a low of 65 °F to 98 °F. The average temperature in December ranges from a low of 35 °F to 55 °F. Snowfall is not common in the lower elevations; however, moderate to heavy amounts of snowfall is common above 3,000 feet. Relative humidity during the summer months is usually less than 30% during the day and rises to about 50% at night. Winter humidity usually exceeds 50%.

B. BACKGROUND

Wildfire is a natural component in the evolution of vegetation in the 603,854-acre Cottonwood Creek Watershed, located between Redding and Red Bluff, California. Vegetation in the watershed is characterized by grass and understory vegetation, forest and hardwood litter, dormant brush and slash, and chaparral brush.

Much of the vegetation has evolved and co-existed with fire for many years and is either dependent on fire or has adapted to the fire regime associated with the area. However, historical vegetation communities in the watershed were likely very different from today's flammable environment. The open stands of trees and diversity of ecosystems encountered by the first Europeans were largely the result of human resource management through the use of fire and frequent accidental and lightning fires. Native Americans did not simply use the resources of the forest as they found them. There is growing evidence that they actively managed the land using fire to encourage certain plant and animal species and to create and maintain desirable landscapes. The Native Americans were apparently the most important influence on the timing and location of fires, and, therefore, contributed to the maintenance of the fire-dependent ecosystem.

Successful fire suppression activities for over eighty years in the western United States and in the planning area in particular, have significantly increased the volume and type of fuels across the landscape. The result is a Very High Fire Hazard Severity Zone Rating throughout the planning area by CAL FIRE **(Map 2)**. 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 has been 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.

II. GOALS AND OBJECTIVES

A. ORIGINAL GOALS AND OBJECTIVES (2003)

- Conduct a fuel inventory and develop a fuel map.
- Run the Fire Behavior Predictions and Fuel Model System (BEHAVE) and interpret the results.
- Develop maps illustrating population centers, roads, vegetation types, and fire history.

- Develop a strategic fuels reduction plan.
- Analyze biomass processing opportunities.
- Identify long-term maintenance opportunities for fuelbreaks.
- Develop a priority list of recommendations for fuel reduction or fire-safe projects.
- Encourage ongoing maintenance of all projects to protect the network.

B. ADDITONAL GOALS AND OBJECTIVES (2010)

- Review existing projects, identify, and map new fuel reduction projects that will provide for human safety, minimize private property loss, and minimize the potential of a wildfire burning into communities.
- Conduct asset risk assessment and prioritization of the proposed projects.

III. METHODOLOGY

The activities necessary for the update of the *Cottonwood Creek Watershed Strategic Fuels Reduction and Management* (Plan) include:

Activity	Actions Taken
Meet with Cottonwood Creek Watershed Group Board/Fire Safe Council, CCWG members, landowners, and representatives from local agencies about the scope of the plan update.	Met with CCWG Board/FSC on 10/08/09, TAC meeting with fire agencies on 12/09/09, CC community meeting on 2/10/10.
Present information to the CCWG Board, CAL FIRE, Shasta County Fire Department, BLM and local landowners for review and assistance in assessment of risk, identification of WUI's, and prioritization of fuel reduction projects.	Presented draft plan at _____
Evaluate values at risk, such as structures and natural resources.	12/05/09 TAC meeting, 2/10/10 community meeting, and _____meetings.
Coordinate with agencies on their management objectives in the watershed.	Confirmed exisiting agency management objectives with agency representatives and carried forward to this plan update
Identify long term maintenance options for fuelbreaks.	Reviewed discussion of options in the 2003 plan with the TAC and carried forward to this plan update.
Identify mechanical treatments and possible uses of excess fuels.	Reviewed the mechanical treatment options in the 2003 Plan with the TAC and carried the options forward to the plan update.
Develop a priority list of recommendations	Developed the priority list of

Activity	Actions Taken
and potential funding sources.	recommendations with the TAC. Carried forward the potential funding sources from the existing plan
Complete a draft fuels reduction plan update for review by the TAC.	
Present a draft fuels reduction plan to the community, and incorporate recommendations into the final plan.	

IV. RECOMMENDED ACTIONS

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 tree 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
- Road access for fire crews

A. MANAGEMENT ACTIONS

1. Encourage and participate in the creation of defensible space and support of a Firewise Program for neighborhoods throughout the planning area. Cottonwood Creek community members can reduce structural ignitability throughout the planning area by implementing defensible space/Firewise Programs to include the following:

    - Assess risk/structure ignitability.
    - Upgrade existing structures to fire safe building codes.
    - Replace wood roofs with approved fire safe roofing.
    - Consider fire resistant exterior siding.
    - Maintain a minimum 100-foot defensible space around structures.
    - Clean roofs and gutters annually.
    - Develop a community phone tree in case of a fire emergency.
    - Develop agreeements with the county to use the reverse 911 system.
    - Remove ladder fuels.
    - Clean and screen chimneys.
    - Maintain green grass and fire resistant plants within 30 feet of structures.
    - Move all flammable material such as wood piles, propane tanks, etc. at least 30 feet from homes.
    - Remove dead, dying, or dieseased shrubs, trees, dried grass, fallen branches and dried leaves 100 feet around structures.

- Attach a hose that can reach to all parts of the structures.

2. Seek funding to conduct fuel inventories along Platina Road, Bowman Road, and Highway 36 to determine type and scope of future fuelbreaks.
3. Seek funding to Inventory Moon Fire dozer trails to determine which ones to maintain where practical, as per CAL FIRE.
4. Seek funding to Identify and develop strategic water sources, including additional cisterns, throughout the watershed.
5. Seek funding to Illustrate all large ranches, and subdivisions, etc. within the Cottonwood Creek Watershed on a map.
6. Seek funding to identify and develop wildfire safety zones to reduce citizen and firefighter risks from future large wildfires.
7. Seek funding to L\locate and illustrate all existing water sources such as ponds, pools and streams and access routes for fire engines.
8. Seek funding to Install signs at major road intersections to indicate the location of existing water sources within the watershed.
9. Seek funding to Install reflective road signs on private and county roads to help firefighters and other emergency response teams locate and communicate target destinations.
10. Seek funding to develop and disseminate educational information about fire prevention and emergency planning to all residents in the watershed.
11. Seek funding to develop an evacuation plan for the watershed to provide residents with information regarding evacuation procedures, emergency shelters, and safe escape routes.
12. Seek funding to continue CAL FIRE's VMP program within the watershed, concentrating on larger ownerships with an emphasis on noxious weed eradication and converting chaparral to annual grasslands.
13. Seek funding to build or improve road access to existing and developed water sources.
14. Seek funding to identify and map the location of landowners with water hookups for fire engines.
15. Seek funding to Continue to provide property owners with the means to develop defensible space around homes.
16. Seek funding to coordinate work with Roseburg Resources, Sierra Pacific Industries, and Crane Mills to assure fuel reduction activities on their properties are complemented by other fuel reduction projects throughout the Plan area.
17. Seek funding to coordinate fuel reduction projects with Western Area Power Authority and PG&E transmission line clearing and biomass thinning projects.

B. PROPOSED PROJECTS (Maps 6-6b)

The identified fuel reduction projects are primarily roadside shaded fuelbreaks intended to slow down a wind-driven fire, create safe fire access for fire personnel and escape routes for residents. The following section describes the individual projects and the asset values at risk. The following table depicts the project name, type, category, and priority.

TABLE 1
Cottonwood Creek Watershed Fuel Reduction Projects

Project Number	Area of Watershed	Project Name	Unit	Type	Priority
1	Bowman	Benson Rd. FB	Acres to be determined	Shaded FB	1
2	Bowman	Basler Rd. FB	Acres to be determined	Shaded FB	2
3	Bowman	Quail Ridge Rd FB	Acres to be determined	Shaded FB	3
4	Igo	Gas Point Rd. FB	Acres to be determined	Shaded FB	4
5	Igo	Clear Creek Rd. FB	Acres to be determined	Shaded FB	5
6	Igo	Cloverdale Rd, FB	Acres to be determined	Shaded FB	6
7	Ono	Rainbow Lake Rd. FB	Acres to be determined	Shaded FB	7
8	Platina	Harrison Gulch Rd FB	Acres to be determined	Shaded FB	8
9	Central Watershed	Bland Road	Length and equipment contract time to be determined	Disc trail	9

Project Number	Area of Watershed	Project Name	Unit	Type	Priority

10	Central Watershed	Ball Rd Disc trail	Length and equipment contract time to be determined	Disc trail	10
11	State Route 36	SR 36 FB	Length and equipment contract time to be determined	Disc trail	11
12	Platina Rd	Platina Rd Disc trail or FB	Length and equipment contract time to be determined Acres for FB to be determined	Disc trail needed and Fuel Break as needed	12
13	Bowman	Bowman Road FB and Disc Trail	Length and equipment contract time to be determined Acres for FB to be determined	Disc trail as needed and Fuel Break as needed	13

#1 Concern – Poor Fire Acess/Escape along Benson Road: Fuelbreaks would be constructed along that portion of Benson Road that runs on a ridge top (Benson and Quail Roads are very similar to Basler road. Please see photo for Basler Road).

Proposed Solution:

1. Construct disc trail and/or shaded fuelbreaks as needed along Benson Road: Length undetermined x 130 feet on each side of the road.
2. Encourage residents to develop defensible space/Firewise activities around their homes.

Ownership = 100% private
Number of dwellings = 399
Value of dwellings = $88,438,350
Commercial structure =
Value of commercial structure =
Number of people = 1038

#2 Concern – Poor Fire Acess/Escape along Basler Road: Fuelbreaks would be constructed along that portion of Basler Road that runs on a ridge top.

Proposed Solution:

1. Construct disc trail and/or shaded fuelbreaks as needed along Basler Road: Length undetermined x 130 feet on each side of the road.
2. Encourage residents to develop defensible space/Firewise activities around their homes.

Ownership = 100% private
Number of dwellings = 387
Value of dwellings = $85,778,550
Commercial structure =
Value of commercial structure =
Number of people = 1007

Basler Road, similar to Benson and Quail Ridge Roads

#3 Concern – Poor Fire Access/Escape Quail Ridge Road: Fuelbreaks would be constructed along that portion of Quail Ridge Road that runs on a ridge top ((Benson and Quail Roads are very similar to Basler road. Please see photo for Basler Road).

Proposed Solution:

1. Construct disc trail and/or shaded fuelbreaks as needed along Quail Ridge Road. Undetermined length x 130 feet wide.
2. Encourage residents to develop defensible space/Firewise activities around their homes.

Ownership = 100% private
Number of dwellings = 340
Value of dwellings = $75,361,000
Commercial structure =
Value of commercial structure =
Number of people = 884

#4 Concern – Heavy tree and brush growth along Gas Point Road: Fuelbreaks would be constructed along that portion of Gas Point Road beginning at Clear Creek Road and running south on a ridge top.

Proposed Solution:

1. Construct disc trail and/or shaded fuelbreaks along Gas Point Road: Undetermined length x 130 feet on each side of the road.
2. Encourage residents to develop defensible space/Firewise activities around their homes.

Ownership = 100% private
Number of dwellings = 286
Value of dwellings = $63,391,900
Commercial structure =
Value of commercial structure =
Number of people = 744

Gas Point Rd, ~ 1 mi S of Clear Creek Rd.
Note heavy manzanita growth to road edge.

#5 Concern – Heavy tree and brush growth along Clear Creek Road:

Proposed Solution:

1. Construct shaded fuelbreaks along Clear Creek Road from Cloverdale Road to Gas Point Road: Undetermined length x 130 feet on each side of the road.
2. Encourage residents to develop defensible space/Firewise activities around their homes.

Ownership = 100% private
Number of dwellings = 486
Value of dwellings = $107,721,900
Commercial structure =
Value of commercial structure =
Number of people = 1264

Clear Creek Rd, between Gas Point & CCW NE

#6 Concern – Poor Fire Access/Escape Along Cloverdale Road: Fuelbreaks would be constructed along that portion of the Cloverdale Road that runs on a ridge top.

Proposed Solution:

1. Construct roadside disc trail and/or shaded fuelbreaks along Cloverdale Road: Undetermined length x 130 feet on each side of the road.
2. Encourage residents to develop defensible space/Firewise activities around their homes.

Ownership = 100% private
Number of dwellings = 503
Value of dwellings = $111,489,950
Commercial structure =
Value of commercial structure =
Number of people = 1033

Cloverdale Road south of Clear Creek Road. Note trees to edge of road.

#7 Concern – Poor Fire Escape along Rainbow Lake Road:

Proposed Solution:

1. Construct shaded fuelbreak along Rainbow Lake Road to create an escape route: Undetermined length x 50 feet on each side of the road. Work will limited by riparian zones along the road.

2. Encourage residents to develop defensible space/Firewise activities around their homes.

Ownership = 100% private
Number of dwellings = 141
Value of dwellings = $31,252,650
Commercial structure =
Value of commercial structure =
Number of people = 367

Rainbow Lake Road – note heavy tree and brush growth to edge of road.

#8 Concern – Poor Fire Escape along Harrison Gulch Road:

Proposed Solution:

1. Clear vegetation along Harrison Gulch Road to create a fire escape route: Undetermined length x 50 feet on each side of the road. (Avoid the bottom of riparian drainages).
2. Encourage residents to develop defensible space/Firewise activities around their homes.

Ownership = 100% private
Number of dwellings = 14
Value of dwellings = $3,103,100
Number of people = 37

#10 Concern – Fuel continuity along Bland Road (see picture for Ball Road):

Proposed Solution:

1. Construct disc trail fuelbreak along both sides of Bland Road as needed to break continuity of fuel from Middle Fork Cottonwood Creek to Platina Road. Undetermined length.
2. Encourage residents to develop defensible space/Firewise activities around their homes.

Ownership = 100% private
Number of dwellings = 61
Value of dwellings = $13,520,650
Number of people = 159

#11 Concern – Fuel continuity along Ball Road:

Proposed Solution:

1. Construct disc trail fuelbreaks as needed along Ball Road to break continuity of fuel: Undetermined length.
3. Encourage residents to develop defensible space/Firewise activities around their homes.

Ownership = 100% private
Number of dwellings/commercial structures= Provides immediate protection for R Wild Horse Ranch which is a family oriented, shared ownership vacation property that provides outdoor activities such as camping and equestrian activities. The ranch includes numerous RV spaces, 148 cabins, a general store, pool, and recreation center.
Value of dwellings = Undetermined
Number of people = Varies

Ball Road - typical of central "foothill" areas. Parallel is similar to Bland Road.

#16 Concern – Continuous fuel along Platina Road:

Proposed Solution:

1. Construct shaded fuelbreaks and brush clearance as needed along Platina Road from Watson Gulch west to Platina. Undetermined length and acreage.
2. Construct a disc trail to break fuel continuity as needed from Watson Gulch east. Undetermined length.
3. Encourage residents to develop defensible space/Firewise activities around their homes.

Ownership = 100% private
Number of dwellings = 658
Shaded and brush clearance FB = 105
Disc trail FB = 553
Value of dwellings = $145,845,700
Commercial structures =
Value of commercial structure =
Number of people = 1438

Platina Road: Typical areas in need of shaded fuelbreaks and/or brush clearance

Platina Road – note brush and trees to edge of road.

Platina Road – note heavy brush to edge of road.

Platina Road – Typical area where disc trail fuelbreaks could be constructed

C. OVERALL COMMUNITY WILDFIRE RISK ASSESSMENT

BASIC ASSUMPTIONS	
People	2.6 per dwelling
Dwellings	3,275
Property Value ($221,650 per dwelling)	$725,903,750
Schools (2 elementary, 1 high school)	$75,000,000
Power line – 105 miles @ $250,000/mile	$26,250,000

D. OVERALL COMMUNITY PRIORITIES

Community, structure or area at risk	Map Letter	Fuel Hazard	Risk of Wildfire Occurrence	Struc-tural Ignit-ability	Preparedness and Firefighting Capability	Overall Risk	Fire Hazard Severity Zone Rating
Benson Rd. FB	1	High	High	High	Low/High	High	Very High
Basler Rd. FB	2	High	High	High	Low/High	High	Very High
Quail Ridge Rd FB	3	High	High	High	Low/High	High	Very High
Gas Point Rd. FB	4	High	High	High	Low/High	High	Very High
Clear Creek Rd. FB	5	High	High	High	Low/High	High	Very High
Cloverdale Rd, FB	6	High	High	High	Low/High	High	Very High

Community, structure or area at risk	Map Letter	Fuel Hazard	Risk of Wildfire Occurrence	Structural Ignit-ability	Preparedness and Firefighting Capability	Overall Risk	Fire Hazard Severity Zone Rating
Rainbow Lake Rd. FB	7	High	High	High	Low/High	High	Very High
Harrison Gulch Rd FB	8	High	High	High	Low/High	High	Very High
Bland Road	9	High	High	High	Low/High	High	Very High
Ball Rd Disc trail	10	High	High	High	Low/High	High	Very High
SR 36 FB	11	High	High	High	Low/High	High	Very High
Platina Rd Disc trail or FB	12	High	High	High	Low/High	High	Very High

E. OVERALL COMMUNITY HAZARD REDUCTION PRIORITIES

Community, structure or area at risk	Map Number	Overall Risk	Number of Structures at Risk	Cultural Value	Type of treatment	Method of Treatment	Overall Priority
Benson Road FB	1	High	399	Low	Hand Labor	Brush and tree removal, pruning	1
Basler Road FB	2	High	387	Low	Hand Labor	Brush and tree removal, pruning	2
Quail Ridge Road FB	3	High	340	Low	Hand Labor	Brush and tree removal, pruning	3
Gas Point Road FB	4	High	286	Low	Hand Labor	Brush and tree removal, pruning	4
Clear Creek Road FB	5	High	486	Low	Hand Labor	Brush and tree removal, pruning	5
Cloverdale Road FB	6	High	503	Low	Hand Labor	Brush and tree removal, pruning	6
Rainbow Lake Road escape route	7	High	141	Low	Hand Labor	Brush and tree removal, pruning	7
Harrison Gulch Road escape route	8	High	7	Low	Hand Labor	Brush and tree removal, pruning	8
Bland Road Disc Trail	9	High	25	Low	Mechanical and Hand Labor	Prescribed Burning	9

Community, structure or area at risk	Map Number	Overall Risk	Number of Structures at Risk	Cultural Value	Type of treatment	Method of Treatment	Overall Priority
Ball Road Disc Trail	10	High	R Wild Horse Ranch	Low	Hand Labor	Brush and tree removal, pruning	10
Platina Road Disc Trail and FB	11	High	658	Low	Mechanical and Hand Labor	Brush and tree removal, pruning	12
Bowman Road Disc Trail and FB	12	High	378	Low	Mechanical and Hand Labor	Prescribed Burning	13

F. PROJECT MAINTENANCE PRIORITY

Project Name	Map Number	Completed	Maintenance Priority
Moon Fire dozer trails	13	2008	1
Lake California Dr.	14	ongoing	2
State Highway 36	15		3
R Wild Horse Ranch	16		4
Beegum Gorge Road	17	In progress	5
Graves Ranch	18		6

#1 Maintenance Concern – Regrowth of flammable vegetation in the dozer lines constructed during the suppression of the Moon Fire (June 2008).

Proposed Solution:

1. Conduct an inventory of the dozer lines to determine which ones are to be maintained as permanent fuelbreaks.
2. Conduct maintenance of the identified dozer lines through the use of herbicide, and/or mechanical, and/or biological mastication.

#2 Maintenance Concern – Regrowth of flammable vegetation in existing fuel break along California City Drive:

Proposed Solution: Conduct maintenance through use of herbicide, and/or mechanical, and/or biological mastication.

#3 Maintenance Concern – Regrowth of flammable vegetation in existing fuelbreak along Highway 36

Proposed Solution: Conduct maintenance through the use of herbicide and/or mechanical treatment.

#4 Maintenance Concern – Regrowth of flammable vegetation in the existing perimeter fuelbreak around the R Wild Horse Ranch

Proposed Solution: Conduct maintenance through use of herbicide, and/or mechanical, and/or biological mastication.

 # 5 Maintenance Concern – Regrowth of flammable vegetation in the fuelbreaks that are already and currently being constructed within the Sunflower CRMP.

Proposed Solution: Conduct maintenance through the use of herbicide and/or mechanical treatment.

#6 Maintenance Concern – Regrowth of flammable vegetation in the existing fuelbreaks on the Graves Ranch.

Proposed Solution: Conduct maintenance through the use of herbicide and/or biological and/or mechanical treatment.

V. PLAN UPDATE

The Cottonwood Creek Watershed Group, Cottonwood Fire Safe Council and Fire Agencies intend to annually assess progress and invite agencies and landowners to submit additional projects that would provide community protection. Additional new projects will be displayed in an update appendix to this plan and approved by the Shasta County and Tehama Boards of Supervisors.

VI. VALUES AT RISK

A. RESIDENCES AND MAJOR STRUCTURES

According to the 2000 Census, urban development within the Cottonwood Creek Watershed has significantly increased over the past several years, specifically in the Cottonwood and Bowman areas. As more people build homes in these rural areas with severe fire hazard potential, more lives are at risk from increased fire starts. As a result, many homes within the Cottonwood Creek 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.

In Zone I of the CAL FIRE Tehama-Glenn Unit Plan, on the western side of the planning area, the communities of Platina and Beegum are most at risk because they are surrounded by dense chaparral, which poses a serious fire danger. The communities of Igo and Ono are also located in close proximity to chaparral, however, the fire hazard associated with Igo and Ono does not appear to be as severe. A majority of the area associated with Igo and Ono is characterized by annual grasses with oak/gray pine forest throughout. Generally, grasses intermixed with oak/gray pine forest pose a less

hazardous fire hazard in comparison to the chaparral landscapes. However, since this vegetative type encompasses most of the residential development within the watershed, there are particularly dangerous areas such as Zogg Mine Road which is a one way in and one way out fire access and escape route for fire personnel and residents in the area.

In Zone 2 of the CAL FIRE Tehama-Glenn Unit Plan, on the eastern side of the planning area, the assets or values at risk from fire are the many homes located throughout this area, which includes the Bowman Road area, Cottonwood, and the gated community of Lake California. Anderson-Cottonwood Irrigation District (ACID) canals supply irrigation water to numerous ranches in this eastern portion of the watershed and are accordingly emergency water sources for these residential areas. Typically residences in this area are homes on large lots, ranchette style homes with small acreage, and ranches with houses and outbuildings. Lake California is a gated, designed community located in the northeast corner of the planning area and includes moderately-sized structures, a club house complex, small business complex, and a scattering of duplexes and apartments. The structures are typically in grass and oak woodland fuels on ridgelines and hilltops.

B. VEGETATION (MAP 3)

A majority (53%) of the Cottonwood Creek Watershed is composed of Blue Oak/Gray Pine stands with frequently occurring meadows throughout. This vegetation type characterizes the lowest elevation points of the watershed. The mid-elevation areas are characterized by California mixed chaparral species, which make up approximately 16% of the watershed. The higher elevations are composed of mixed conifer, Douglas-fir and true fir stands, which make up approximately 25% of the watershed. The remaining portions of the watershed (4%) are composed of Serpentine species, riparian species, agricultural and urban development, and barren rock. See Table 2 for the Special Status vegetative species found in the Cottonwood Creek watershed.

C. FOREST LAND

The upper reaches of the Cottonwood Creek Watershed contain several thousand acres of federal forestland. Given the high economical and ecological value of wood products, it is considered a valuable asset. Unfortunately, most of these forests are located adjacent to dense, contiguous thickets of chaparral, which creates an extreme fire hazard risk. When wildfires start in the brushy foothills of the watershed, the fire quickly climbs the foothills into the forests and tree canopies, creating a very hazardous condition.

The majority of forestland within the Cottonwood Creek Watershed is publicly owned and managed by the USDA Forest Service. The remaining forestland is owned and managed by Roseburg Resources, Sierra Pacific Industries, Crane Mills Corporation, and several non-industrial forest landowners. The fire and fuels management objectives established by these landowners will be discussed in the following section.

D. FISH AND WILDLIFE (MAP 4)

In general, the watershed provides suitable habitat for a wide variety of wildlife species. The main stem of Cottonwood Creek, in addition to the north, middle, and south forks, provide suitable habitat for anadromous fish species as well as resident coldwater and warm water fish species. The oak woodland, meadows, and chaparral vegetation types appear to provide quality habitat for foraging species and a healthy prey base for predators. The conifer stands, located within the upper reaches of the watershed, also provide foraging opportunities as well as habitat for species that require a dense overstory and an abundance of horizontal structure.

Approximately 130 miles of Cottonwood Creek and its tributaries are accessible to anadromous fish (USFWS, 1980). Fall-run, late-fall run, and spring run Chinook salmon and steelhead use various reaches depending on life history needs. Adult fall-run Chinook salmon ascend Cottonwood Creek and spawn in late October through November (Cottonwood Creek Watershed Assessment, 2001). Juvenile salmon begin migrating following emergence as early as December, and smolts continue to leave the stream through May (CDFG, 1978).

Historically, an estimated 1,000 to 1,500 adult fall-run Chinook salmon return to spawn in Cottonwood Creek each year. Over the last several years, however, the fall-run has declined drastically throughout the Sacramento River watershed to the lowest levels ever recorded (The Pacific Fishery Management Council, February 2009), and it appears that the 2009 fall-run is lower than 2008. The California Department of Fish & Game estimate fewer than 500 late-fall run and fewer than 500 spring-run Chinook salmon return to spawn in Cottonwood Creek each year (CDFG, 1993). *The Final Restoration Plan for the Anadromous Fish Restoration Program* (USFWS, USBR, 2001) established a population target of 5,900 Chinook salmon for the Cottonwood Creek Watershed.

The California Natural Diversity Data Base (CNDDB) was queried to determine which "special status" fish, wildlife, and plant species have been noted within the Cottonwood Creek Watershed. The term "special status" refers to those species that have some form of federal or state protection or are being considered for legal protection. The following table lists those species.

TABLE 2
SPECIAL STATUS SPECIES NOTED WITHIN THE COTTONWOOD CREEK DRAINAGE (CNDDB, 2009)

Scientific name	Common Name	Status[1]
Actinemys marmorata	western pond turtle	CSC
Anisocarpus scabridus	scabrid alpine tarplant	CNPS-1B
Antrozous pallidus	pallid bat	CSC
Ascaphus truei	Pacific tailed frog	CSC
Astragalus rattanii var. jepsonianus	Jepson's milk-vetch	CNPS-1B
Balsamorhiza macrolepis var. macrolepis	big-scale balsamroot	CNPS-1B
Carex scoparia	pointed broom sedge	CNPS-2

Scientific name	Common Name	Status[1]
Castilleja rubicundula ssp. rubicundula	pink creamsacs	CNPS-1B
Corynorhinus townsendii	Townsend's big-eared bat	CSC
Cryptantha crinita	silky cryptantha	CNPS-1B
Dendroica petechia brewsteri	yellow warbler	CSC
Epilobium oreganum	Oregon fireweed	CNPS-1B
Epilobium siskiyouense	Siskiyou fireweed	CNPS-1B
Eriastrum brandegeeae	Brandegee's eriastrum	CNPS-1B
Eriastrum tracyi	Tracy's eriastrum	CNPS-1B
Eriogonum ursinum var. erubescens	blushing wild buckwheat	CNPS-1B
Erythronium revolutum	coast fawn lily	CNPS-2
Haliaeetus leucocephalus	bald eagle	Fed. Delist.
Harmonia doris-nilesiae	Niles' harmonia	CNPS-1B
Harmonia stebbinsii	Stebbins' harmonia	CNPS-1B
Juncus leiospermus var. leiospermus	Red Bluff dwarf rush	CNPS-1B
Leptosiphon nuttallii ssp. howellii	Mt. Tedoc leptosiphon	CNPS-1B
Martes americana humboldtensis	Humboldt marten	CSC
Martes pennanti (pacifica) DPS	Pacific fisher	C-Cand./ Fed.-Cand.
Oncorhynchus tshawytscha spring-run	Central Valley spring-run chinook salmon ESU	Fed.-Threat.
Pandion haliaetus	osprey	CA Delist.-CFPRs
Perognathus inornatus inornatus	San Joaquin pocket mouse	CSC
Rana boylii	foothill yellow-legged frog	CSC
Riparia riparia	bank swallow	CT
Spea hammondii	western spadefoot	CSC
Taxidea taxus	American badger	CSC

Notes: [1]Fed.Threat.=Federally Threatened; Fed.-Delist.=Federally Delisted; Fed. Cand.—Federal Candidate for Listing; CT=CA Threatened; CSC=CA Species of Concern; CNPS-1B=Rare and Restricted to CA; CNPS-2=Rare in CA, more common elsewhere.

E. WATER QUALITY

The Cottonwood Creek Watershed has an annual runoff of 586,000 acre feet. There is a limited amount of snowpack that can accumulate in any given year due to the area's relative low elevations. This reduces seasonal storage opportunities and produces a hydrology with abrupt swings closely correlated to storm events. Watershed runoff is flashy, high in the rainy season, and low in the dry season.

The water quality of Cottonwood Creek is generally considered good from a drinking water standard perspective. There is some concern regarding the South Fork's regular contribution of suspended sediments and turbidity to the mainstem. Surface water flowing from burned areas may carry increased levels of sediment, organic debris, and chemicals that may contribute to significant degradation of water quality and habitat.

F. SOILS)

The Soil/Vegetation Survey of California, conducted by the Pacific Southwest Forest and Range Experimental Station, describes soil types including those with a moderate-to-high Erosion Hazard Rating (EHR). Information in the *Cottonwood Creek Watershed Assessment* confirms 98% of the soil types within the watershed meet the criteria for a moderate-to-high EHR. The remaining soil types were characterized by either a slight EHR or a very high EHR.

High intensity wildfire damages soil by incinerating roots and the humus layer (organic portion of soils) that hold soils together and provide 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 as well, 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 this time is lost time in maintaining and building up the soils. Overtime, 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. Fortunately in this area of California, there exist relatively young volcanic soils in the mountains and recent alluvial soils in the valleys that can tolerate fire without immediately showing the negative effects. Continued burning though can have long-term negative effects (Richards, 2002).

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 120 -degrees F (DeBano 1970).

VII. 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; 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 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. CAL FIRE

CAL FIRE is responsible for fire suppression on privately-owned wildlands and provides emergency services under cooperative agreements with the counties. CAL FIRE has two seasonal fire stations in the Tehama side of the Cottonwood Creek Watershed, Paskenta Station and Baker Station, as well as a cooperative station with Tehama County located in the central Bowman Road area.

The State Board of Forestry and CAL FIRE have recently 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 pre-fire management prescriptions and increasing initial attack success. CAL FIRE'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.

The overall goal is to reduce total costs and losses from wildland fire in California by protecting assets at risk through focused prefire management prescriptions and increasing initial attack success. To accomplish this, the California Fire Plan has five strategic objectives:

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

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, dwellings, watershed resources such as water, timber, wildlife, habitat, unique areas, recreation, range structures, and air quality.

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

In the Cottonwood Creek Watershed, CAL FIRE is responsible for wildland fire protection on all ownerships, except those managed by the Whiskeytown National Recreation Area (WNRA) in the northwest section of the watershed. CAL FIRE 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 the WNRA. The cooperative agreement, in conjunction with the California Cooperative Fire Agreement on Wildland Fire Suppression between CAL FIRE, USDA Forest Service, National Park Service, and Bureau of Land Management, outlines the cooperative sharing of resources for wildland fire suppression, since wildfires do not recognize political or ownership boundaries.

It is CAL FIRE's practice to develop separate fire plans for each Unit. Since the Cottonwood Creek Watershed is in both Tehama and Shasta Counties, there are two separate CAL FIRE plans. Following is a discussion of each Unit Fire Plan:

1. **Tehama-Glenn Fire Management Plan (2005)**

The goal of this plan is to reduce the destruction and associated costs from wildfire by protecting assets at risk through focused pre-fire management prescriptions, improved initial attack success, stakeholders cooperation, public education, preparation of fuels, evaluation and validation of data provided from historical and current fire information, and weather factors. The document is intended to provide a foundation from which communities can assume a cooperative role in the effort to improve fire and life safety. The content of this report is cooperative effort between the California Department of Forestry and Fire Protection and the Tehama Fire-Safe Council.

This plan utilizes five strategic objectives to construct the Fire Plan Framework as identified in the California Fire Plan, and incorporates them into the planning and implementation process. The five objectives and framework components of the Tehama-Glenn Fire Management Plan are as follows:

- Wildfire Protection Zones – To create wildfire protection zones by identifying unique objectives that are specific to the landscapes and land uses found there, in order to reduce the risks to citizens and firefighters
- Initial Attack Success – Assess the initial attack fire suppression successes of wildland fires on lands of similar vegetation type. This is measured in terms of a percentage of fires that are successfully controlled before unacceptable costs and losses occur. The analysis can be used to determine the Department and Unit's level of service.

- Assets Protected – The plan utilizes a methodology for defining assets protected and their degree of risk from wildfire. The assets at risk addressed in the plan are life safety (citizen and firefighter), watersheds and water quality, timber, wildlife and wildlife habitat (including rare and endangered species), rural communities, unique areas (scenic, cultural, and historic), recreation, range, property in the form of structures, and air quality. Stakeholders for each of the assets at risk are identified; their input helps to guide the pre-fire decision-making process of CDF and other fire service managers as well as that of the local Fire Safe Councils.
- Fire Management Prescriptions – Fire management prescriptions focus on alternative means of protecting assets at risk. Projects include a combination of fuel modification, ignition management, fire-wise planning and education, and pre-development planning. Specific activities include but are not limited to land-use planning and associated regulation, educational programs and public information, department infrastructure including fire stations and water systems, fuels management and forest health. Pre-fire management prescriptions will also identify those who will benefit from such work and consequently those who should share in the project costs.
- Fiscal Framework – The State Board of Forestry and CDF has addressed the fiscal framework for assessing and monitoring annual and long-term changes in California's wildland fire protection systems through the Fire Safe Councils and the Wildland Urban Interface (WUI) grants.

The CAL FIRE Tehama-Glenn Unit Fire Plan identifies ten Zones of which Zones 1 and 2 are within the Cottonwood Creek Watershed. Zone 1 includes the communities of Paskenta, Red Bank, and R-Wild horse Ranch. Annual grass species are usually the major carrier of fire in the eastern portion of Zone 1. Fires in this type are characterized as fast moving, strongly influenced by local wind, humidity, and terrain. Many species of brush grow throughout Zone 1; however, manzanita is the most fire prone. Annual grasses usually surround brush patches and these grasses can carry flames into the brush canopy if the leaves are close to the ground. In the western portions of Zone 1, Oak Woodland transitions to dense Chaparral brushland. The foothill areas near R-Wild Horse Ranch, Canyon Loop, Colyear Springs Road, and lands west of Paskenta consist of mixed chaparral with large amounts of Chamise. Mature Chamise patches can burn with ferocious fire intensity during the late fire season. Fires in Zone 1 that involve both grass and brush greatly increase the danger and severity of a wildland fire. Late summer fires in chaparral often involve thousands of acres, a major ground and air firefighting force and large losses to improvements and natural resources.

The priority rating for Zone 1 is Moderate. The CAL FIRE Action Plan includes the following actions:

- Utilize vegetation management practices to reduce and modify fuel loading.
- Enforce the annual burn ban.
- Continue fuelbreak construction and maintenance in the Pellows area.
- Continue fire prevention school programs at area schools.

- Promote additional fire prevention education among the general public.
- Focus fire prevention programs on hardwood harvesting operations.
- Focus law enforcement activities on equipment violations and arson.
- Conduct an agricultural equipment inspection program.
- Conduct Red Flag patrols and public contacts.
- Review the effectiveness of initial attack capabilities at Baker Station.
- Review the effectiveness of detection capabilities including loss of Pattymocus Lookout.
- Review the Risk Rating Area for special treatment zones.

Zone 2 includes the communities of Cottonwood, Bowman, Wilcox, and Dibble Creek. It. is bordered by Cottonwood Creek to the north, Luce and Griswold Road, Highway 36 West, and Bowman Road to the west and the Sacramento River to the east. Zone 2 vegetation consists of a mixture of grass rangeland, oak woodland, and brush dominated by manzanita. Blue and live oaks are the dominant tree species in the area along with lesser amounts of valley oak and foothill pine. Fires in this type are characterized as fast moving, strongly influenced by local wind, humidity, and terrain.

The Priority Rating for this zone is <u>High</u>. The CAL FIRE Action Plan for this zone includes the following actions:

- Utilize vegetation management practices to reduce and modify fuel loading.
- Enforce the annual debris burn ban.
- Identify, construct, and maintain fuelbreak locations.
- Work with CalTrans and Public Works on roadside fuel modification.
- Develop a fire protection water supply infrastructure.
- Continue fire prevention school programs at area schools.
- Promote additional fire prevention education among general public.
- Focus Law enforcement activities on debris burning and arson.
- Conduct equipment inspections.
- Conduct Red Flag patrols and public contacts.
- Conduct power line inspections.
- Review the effectiveness of initial attack capabilities at the Bowman station.
- Review the special treatment zones.

2. <u>Shasta-Trinity Unit Management Plan (2008)</u>

The Shasta-Trinity Unit Fire Management Plan documents the assessment of the wildland fire potential within the Unit. It includes stakeholder contributions, priorities, and identifies strategic targets for pre-fire solutions. The goal of this plan is to reduce total cost and losses from wildfire by protecting assets at risk through focused prefire management prescriptions and increasing initial attack success. This plan utilizes the five strategic objectives and fire plan framework identified in the *California Fire Plan* and incorporates them into the planning and implementation process composed of:

- Wildfire Protection Zones
- Initial Attack Success

- Assets Protected
- Prefire Management
- Fiscal Framework

Both Shasta and Trinity Counties have a history of large and damaging fires. The continued urbanization of the Unit's wildland areas significantly increases both the damage and ignition potential. It is imperative that the Unit continues to have accurate and current assessments. The Unit must also, while working with local government and stakeholders, incorporate the fire plan analysis into current and future policy decisions when they relate to the wildland areas. Significant amounts of the population and their properties are at risk within the Unit. Residents must provide and maintain a defensible space around their properties. Fuels along existing roadways should also be maintained in order to ensure safe passage. Fuelbreaks and post-fire fuel management are required to help alleviate the risk of fire and help restore a healthy wildland environment. To achieve these; education, enforcement, fuels management and financial assistance should continue to be made available.

Pre-fire planning and fuels management projects including those identified by the Vegetation Management Program and the California Forest Improvement Program should receive specific line item status in the California budget. Prevention and education efforts must continue and when possible, concentrate on the reduction or elimination of preventable fire ignitions.

In summary, CAL FIRE believes that cooperative fire protection, fuels reduction, and fire prevention must be linked and an extensive network of collaboration in order to have future success in dealing with the wildfire problems within the Cottonwood Creek Watershed.

C. SHASTA TRINITY NATIONAL FOREST

The USDA Forest Service is responsible for managing approximately 122,830 acres in the Cottonwood Creek Watershed, of which a portion is designated the Yolla Bally-Middle Eel Wilderness Area. The Shasta Trinity National Forest completed a Fuels Analysis and Strategy to provide a basis for managers to make decisions concerning placement and priorities of fuels management projects. It is a Forest level analysis meant for Forest level considerations. The report states it may also be used as a tool for project level planning.

The analysis characterizes the Shasta Trinity National Forest in terms of hazard, risk, and value. Hazard is defined as fire behavior potential, which has implications for resource damage as well as suppression capability. Risk is the probability of a fire occurring based on local fire history. Value refers to the monetary, ecological, or political worth of a definable area. All three areas (hazard, risk, and value) are quantified by a measure of low, moderate, or high through a combined use of scientific data and technical expertise, and displayed in a GIS map. The three are then combined in an overall rating.

The final step of this analysis prioritizes the Forest in terms of critical fire danger areas based on the hazard, risk and value ratings and management needs. These priorities align with the *National Fire Plan* and the cohesive strategy and will guide resource management considerations on the Forest, such as natural fuels project priorities and identification of essential road access for protection purposes. The national priorities are wildland-urban interface, readily accessible municipal watersheds, threatened and endangered species habitat, and maintenance of existing low risk Condition Class I areas.

The goals related to fire management within the Shasta Trinity National Forest (STNF), pursuant to the Shasta Trinity Fire Management Plan (STNF 2001), are as follows:

- Restore fire to its natural role in the ecosystem when establishing the desired future condition of the landscape.
- Achieve a balance of fire suppression capability and fuels management investments that are cost effective and able to meet ecosystem objectives and protection capabilities.
- Prepare Fire Management Plans that will consider and define the circumstances to use in confine, contain, and control suppression strategies.
- Wildfire suppression tactics will favor the use of natural barriers, topography or watercourse, and low impact techniques. After fires are declared out, take appropriate actions to rehabilitate and/or restore the site.
- Locate incident bases and staging areas outside of wilderness. When necessary, within a wilderness, use small (50-60 people) suppression camps in areas where degradation of water quality can be avoided. Return sites to a pre-use condition.
- Permit heliports when approved by the Forest Supervisor. Use natural openings to the extent possible.

To meet those goals, fire management direction in the *Shasta Trinity Land & Resource Management Plan* states:

- Wildland fires will receive an appropriate suppression response that may range from confinement to control. Unless a different response is authorized in this plan or subsequent approved plans, all suppression response will have an objective of control.
- All wildland fires, on or threatening private land protected by agreement with the State of California, will receive a control suppression response.
- Activity fuels that remain after meeting wildlife, riparian, soil, and other environmental needs, will be considered surplus and a potential fire hazard. The amount and method of disposal will be determined in the ecosystem analysis, a project level decision.
- Plan and implement fuels treatments emphasizing those treatments that will replicate fire's natural role in the ecosystem.
- Natural fuels will be treated in the following order of priority: 1) public safety; 2) high investment situations (structural improvements, power lines, plantations, etc.); 3) known high fire occurrence areas; 4) coordinated resource benefits, i.e., ecosystem maintenance for natural fire regimes.

- Consider fuelbreak construction investments when they compliment forest health/biomass reduction needs, when very high and extensive resource values are at risk, and to protect forest communities.
- Design fire prevention efforts to minimize human-caused wildfires commensurate with the resource values-at-risk.
- Assess brush fields (chaparral) for multi-resource management opportunities, and develop project plans for treatment. Selection of the treatment methods used will be guided by the following criteria:

    1) The effectiveness of producing multi-resource benefits through modification of the specific vegetation associations;
    2) The cost effectiveness of the project;
    3) The degree of fire protection provided by conversion;
    4) The risk in watersheds; and
    5) The natural fire regime

D. BUREAU OF LAND MANAGEMENT (BLM)

The BLM manages approximately 29,621 acres in the Cottonwood Creek Watershed. The Redding BLM office has entered into a Cooperative Fire Protective Agreement with the California Department of Forestry and Fire Protection (CAL FIRE), where CAL FIRE is responsible for wildland fire protection on BLM lands.

A majority of the BLM parcels within the watershed have been designated as 'transfer parcels,' which means the parcels are eligible for exchange with other federal or private landowners as a means to consolidate BLM's ownership in other areas. The remaining BLM parcels, which are located directly adjacent to the North Fork, Middle Fork and South Fork of Cottonwood Creek and Beegum Creek, will be maintained as part of BLM's ownership and be managed as sensitive areas. Sensitive areas have been established by BLM in response to the potential Wild and Scenic Rivers designation that may be imposed on the North Fork, Middle Fork and South Fork of Cottonwood Creek and Beegum Creek. To protect the potential for designation, no mechanized equipment is allowed within the sensitive areas.

Fuels management on these lands is guided by the Bureau of Land Management, Redding Field Office, *Fire Management Plan* (12/2004). This plan is a general guide that covers all facets of fire management. Specific to fuels management, it sets objectives for focusing work on the WUI and recognized Communities at Risk, and identifies a range of treatment options that could be utilized, consisting of prescribed fire along with non-fire fuels treatments (mechanical, chemical and biological). Targets are to treat 1/100 to 1/50 of the land base every ten years with prescribed fire and to treat 3/100 to 3/50 of the land base every ten years with a non-fire fuels treatment.

E. WHISKEYTOWN NATIONAL RECREATION AREA (WNRA)

A very small portion (627 acres) of the 42,500-acre WNRA is located in the northern portion of the watershed at the head of the North Fork of Cottonwood Creek. To achieve the objectives of the WNRA fire management program, the Cottonwood Creek portion

has been declared a fire suppression zone. All lightning and human-caused wildfires originating from or threatening the area will be suppressed (confined, contained, controlled, or a combination). Mechanical fuel manipulation and management-ignited prescribed fires may be used to reduce fuels and maintain vegetative mosaics and wildlife habitats that approximate natural conditions and ecosystem processes within the area.

The *Whiskeytown Fire Management Plan* has a specific goal relating to fuels management. The goal is:

- Reduce hazard fuels adjacent to developed areas, urban interface boundaries, and cultural/historical sites.

The *Whiskeytown Resource Management Plan* provides three management objectives which relate to fire management:

- Protect the diversity of natural ecosystems, which are found within the Whiskeytown Unit.
- Restore and maintain natural processes in areas of Whiskeytown affected by past and present human-caused impacts.
- Reduce hazardous fuel accumulations throughout Whiskeytown through the use of ecologically sound techniques, and restore fire to the ecosystem through prescribed fire.

The five year objective is to reduce hazard fuels in developed areas, urban interface boundaries, and cultural/historic zones to a level where at 90^{th} percentile weather conditions, average flame lengths would be four feet or less. The desired outcome is that the fuel conditions in strategic areas adjacent to urban interface boundaries, developed areas, and cultural/historic sites are maintained at a level such that the values-at-risk are adequately protected from wildland fire.

Strategies to attain this are:

- Establish shaded fuelbreaks based on fire risk and maintain existing fuelbreaks as needed.
- Use mechanical treatments to reduce hazard fuels in areas directly adjacent to Whiskeytown facilities and inholdings.
- Use prescribed fire and mechanized hazard fuel reduction in strategic urban interface boundary areas to reduce the threat of wildland fire spreading outside the boundaries of Whiskeytown.
- Apply mechanical hazard fuel reduction adjacent to targeted significant cultural and historic sites to protect from fire damage.
- Monitor the effects of prescribed fire and mechanical fuel reduction treatments so that their effectiveness and resource impacts are identified and incorporated into future planning.

F. 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.

G. TEHAMA FIRE COUNCIL

The Tehama Fire Council formed in the spring of 2000 to be an advisory group and work with established fiscal agents, such as Resource Conservation Districts and watershed groups on funding for specific projects relating to fire management, fuel reduction, and fire prevention. A steering committee provides general guidance for the council by prioritizing discussion issues, coordinating meetings, and leading collaborative projects. The priority issues include:

- Smoke management and self regulation
- Coordination on prescribed burning
- Coordination on wildfire incidents
- Public education
- Fire prevention education
- Fire training for land managers
- Prescribed and emergency response fire capacity
- Rehabilitation after wildfire incidents
- Fuelbreak and vegetation treatment projects
- Monitoring of regulatory and institutional environment
- Alternative funding for traditional and innovative fire-safe projects

H. INDUSTRIAL FOREST LANDOWNERS

There are three major private industrial forest landowners in the Cottonwood Creek Watershed: Roseburg Resources, Sierra Pacific Industries, and Crane Mills. The land management objectives for these property owners may vary due to the need for different species and sizes of wood for their manufacturing facilities. The facilities owned by these companies produce a wide variety of products, such as plywood, windows, doors, framing material, decking, fencing, and much more. When it comes to protecting the forest land, their most valuable asset, from wildfire, their goals are very much the same. There are stiff requirements for all contractors and employees working in the forest during fire season.

Typically, all contractors and employees permitted on private forest land are required to make every effort and take all precautions necessary to prevent fires. A sufficient supply of hand tools are maintained on a job site at all times for fire fighting purposes only. Tools include shovels, axes, saws, backpack pumps, and scraping tools. Each forest worker, employee, or person permitted on private forest land is required to take immediate action to suppress and report any fire on or near the property.

On all fires, a sufficient number of people stay on a fire until it is known that adequate action has been taken by CAL FIRE or the agency taking primary responsibility for putting out the fire. All people and equipment remain until released by the agency in charge, or for a longer period, if considered necessary by the land manager.

During fire season, most companies conduct daily aerial patrols covering their forest operations and pay special attention to those areas where work is being conducted, even hours after workers have left the area.

Typically there are specific treatments detailed for care of limbs and other woody debris (often called slash) created by harvest operations in order to minimize fire hazards. It can include piling and burning slash no later than April 1 of the year following its creation, or within a specified period of time after fire season, or as justified in the associated Timber Harvest Plan. The slash and any trees knocked down by road construction or timber operations, within 100 feet of the edge of the traveled surface of public roads, and within 50 feet of the edge of the traveled surface of permanent private roads open for public use where permission to pass is not required, are typically lopped for fire hazard reduction, then piled and burned, chipped, buried or removed from the area . Lopping is defined as severing and spreading slash so that no part of it remains more than 30" above the ground. All woody debris created by harvest operations greater than one inch (1") and less than eight inches (8") in diameter within 100 feet or permanently located structures maintained for human habitation are removed or piled and burned. All slash created between 100-200 feet of permanently located structures maintained for human habitation are usually lopped (cut) for fire hazard reduction, removed, chipped or piled and burned. Lopping may be required between 200-500 feet from a structure if an unusual fire risk or hazard exist has been determined.

I. OTHER PRIVATE

The watershed is 603,427 acres of which 166,040 are in public ownership and 437,387 are in private ownership. Timber holdings are 27,360 acres and acreage in the Williamson Act is 197,080. (Cottonwood Creek Watershed Assessment Table 11-1) Driving through the watershed one notices the predominant valley ownership, except in specific population areas, is grassy open space typically used for grazing. In the timbered foothills and mountains, private homes are scattered about. Land management objectives other than for grazing activities are difficult to discern.

VIII. ANALYSIS OF FUEL MODELING AND FIRE CONDITIONS

A. FIRE HISTORY (MAP 6)

The fire history of the area indicates that lightning is the greatest single cause of fires. In spite of the higher number, lightning fires tend to be smaller in size and are normally associated with some precipitation. A few lightning fires, which have grown to larger than 300 acres in size, had relatively little precipitation and grew in size during the night and during periods of limited firefighting resources. Next to lightning, equipment operations, including chainsaws, welding, and mowing, caused the most fires. (CDF

Tehama-Glenn Unit Fire Plan, 2002). Although details were not available for this report, fires may start along railroad tracks since a major freight and passenger railroad line runs north-south parallel to Interstate 5 through the eastern portion of the watershed.

CAL FIRE and USFS maintain databases on large fires and fire starts within and around their Forest Protection Zones (FPZ). The CAL FIRE database also includes fires recorded within the NPS FPZ. Both databases include the year of fire start, large fires, and total fire acreage, but cause of fire is included only on CAL FIRE fire start data and USFS large fire data.

TABLE 3
INCIDENCE OF FIRES IN THE
COTTONWOOD CREEK WATERSHED[1]

Decade	Total Acres Burned
1910s	948
1920s	2013
1930s	63517
1940s	122,057
1950s	64,187
1960s	3415
1970s	99,641
1980s	13,052
1990-2001	14,562
2002-2009	145,849
Total	393,153

B. FUEL, 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.

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 is the amount of water in a fuel, expressed as a percentage of the ovendry weight of that fuel. For example, a fuel sample can be found to have 20-60% moisture content.
- Fuel loading is defined as the ovendry weight of fuels in a given area, usually expressed in bone dries 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.

[1] Cottonwood Creek Watershed Strategic Fuels Reduction and Management Plan, 2002. CAL FIRE, 2009

- 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.

Within the lower elevations of the Cottonwood Creek 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.

During the fire season (June-October), daily temperature within the Cottonwood Creek Watershed are usually in excess of 90° Fahrenheit and relative humidity is typically less than 30%. When combined, these conditions create an extreme fire danger during the summer months; therefore, fuels management activities are typically conducted during late fall, winter and early spring.

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. 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 fire prevention projects or initiating fire suppression activities.

C. FUEL MODELS

The goal of the fuel inventory is to identify high fuel-loading areas and collect data that could be used as a tool to plan fire protection activities.

Fuels are made up of the various components of vegetation, live and dead, that occur on a given site. Fuels have been classified into four groups: grasses, brush, timber, and slash. The differences in fire behavior among these groups are basically related to the fuel load and its distribution among the fuel diameter-size class. In 1972, thirteen mathematical fire behavior models or Fuel Models were developed by Rothermel (1972) 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.

The fuel models were designed to estimate fire behavior during severe fire hazard conditions when wildfires pose greater control problems and severely impact natural resources. Fuel models are simply 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.

Five of the thirteen fuel model types are present in the Cottonwood Creek watershed., in the watershed. The five fuel types make-up 97% of the vegetation within the watershed. The remaining balance of the vegetation types or land types is comprised of riparian vegetation, serpentine vegetation, barren rock, water bodies, and urban development.

The following table illustrates the fuel models, vegetation types, or land types in the watershed, and the acreage:

TABLE 4
FUEL MODEL TYPES

Fuel Model	Fuel Complex	Total Acres
	Grass and Grass-Dominated	
1	Short Grass (1 foot)	
2	Timber (grass and understory)	192,609
3	Tall Grass (2.5 feet)	
	Chaparral and shrub fields	
4	Chaparral (6 feet)	
5	Brush (2 feet)	23,730
6	Dormant brush, hardwood slash	75,396
7	Southern rough	
	Timber litter	
8	Closed timber litter	
9	Hardwood litter	132,292
10	Timber (litter and understory)	163,112
	Slash	
11	Light logging slash	
12	Medium logging slash	
13	Heavy logging slash	
	Other	
	Agriculture	6,456
	Riparian Vegetation	333
	Serpentine Vegetation	6,090
	Barren Rock	578
	Water Bodies	503
	Urban Development	2,755
	Total	**603,854**

IX. FUEL TREATMENTS

Reducing fuel loads is one of the most effective elements of any fire prevention and protection program. Although fire is an integral component of the Cottonwood Creek

Watershed ecosystem, managing fire by 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.

A. PRESCRIBED BURNING

Advantages of prescribed fire include the low cost of implementation and the large area that can be treated at one time. Some of the negative aspects of prescribed fire are a potential for erosion, the smoke created, the limited time frame to implement, the risk of escape, non-feasibility in small areas, and that 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 clear ground of dangerous fuels like dead wood and brush. This low-intensity fire is vital to the life cycles of fire-dependent 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 concerns 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) (CAL FIRE 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 going 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 when considering 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 the California Department of Forestry and Fire Protection (CAL FIRE) 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 USDA Forest Service land to state parks. According to FRAP, 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.

B. SHADED FUELBREAKS

Shaded fuelbreaks are constructed as a means to create a defensible space in which firefighters can conduct relatively safe fire suppression activities. Fuelbreaks may also slow the progress of a wildfire enough to allow supplemental attack by firefighters. The main idea behind fuelbreak construction is to break up fuel continuity to prevent a fire from reaching the treetops where it becomes explosive, thus keeping the fire to stay on the ground where it can be more easily and safely extinguished. The fuelbreak also slows down a wildfire and often the fire drops to the ground where the only fuel available thereby making the fire easier to extinguish. Fuelbreaks may also be utilized to replace flammable vegetation with less flammable vegetation that burns less intensely. A well-designed shaded fuelbreak 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 needs to strengthen community fire defense systems, improve forest health, and provide environmental protection. The California Board of Forestry rules allow a Registered Professional Forester (RPF) to use a special silviculture prescription when constructing or maintaining a community fuelbreak, exempts community fuelbreaks from

an assessment of maximum sustained production requirements and allows defensible space prescriptions to be used around structures.
The Cottonwood Creek FSC has adopted the following fuelbreak standards:

- The typical minimum width of a shaded fuelbreak is 100 feet, but can be up to 300' wide. The appropriate width is highly dependent on the slope, fuel density, fuel type, fuel arrangement, and landowner cooperation.
- Fuelbreaks 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 fuelbreak are varied to creating a mosaic or nore natural look. Where possible, fuelbreaks should compliment natural or man-made barriers such as meadows, rock outcroppings, and roadways.
- A maintenance plan should be developed before construction of a fuelbreak. Although a fuelbreak can be constructed in a matter of a few weeks, maintenance must be conducted periodically to keep the fuelbreak functioning effectively.
- The establishment of a shaded fuelbreak can lead to erosion if not properly constructed. Short ground cover, such as grass, should be maintained throughout the fuelbreak 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.

The Pile and Burn method is most commonly utilized when constructing fuelbreaks. 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 is called "crush and burn" which combines mechanical fuels treatment with burning. It is more effective at 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.

C. MECHANICAL TREATMENT

Using mechanized equipment for reducing fuels loads on suitable topography and with certain fuel types can be very effective. 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". Studies are underway to use biomass to generate "biofuel."

Mechanical methods to remove fuels include, but are not limited to, the utilization of bulldozers with or without brush rakes, excavators, mechanized falling machines,

masticators, chippers, and grinders. Mechanical treatments conducted with a masticator grind standing brush and reduce it to shreds that are typically left on the ground as mulch. Alternatively, mechanically removed brush may also be fed into a grinder for biomass production to be burned in controlled conditions in wood-fired power plants. A technique called "crush and burn" combines mechanical fuels treatment with on-site burning. As the name implies, the brush is mechanically crushed and then burned. Due to the higher intensity heat created in burn piles, it is more effective at eliminating brush then a low-intensity prescribed burn, which has difficulty overcoming the high moisture content of live chaparral. In addition, it is a good technique for areas adjacent to communities, because fire agencies only burn when fire danger conditions are decreased during the rainy winter months. Mechanical treatments are also utilized on industrial and non-industrial timberlands in which 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 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 treatment will usually necessitate a cultural resource survey, CEQA/NEPA documenttion and compliance, a Naturl Diversity Data Base search, and the prepartation of water quality documents/permits. 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 and air quality must be addressed. The cost of preparing environmnental documents and mitigation measures must be fugured into the budget for any prjojects using mechanical methods.

Due to air quality concerns, the mechanical treatment method is fast becoming the acceptable method of fuel reduction in 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.

D. 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 have the potential to be converted into alternative fuels (biofuels), such as ethanol, methanol, and biodiesel. The typical use of biomass is for as boiler fuel to be used 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 interested in the biomass industry by the release of Executive Order 13134. On August 12, 1999, President Clinton released Executive Order 13134, designed to stimulate 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. However, one of the most widely acknowledged benefits is the potential 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. The Cottonwood Creek Watershed contains thousands of acres of forestland, which produce a substantial amount of renewable biomass each year. The biomass market associated with wood products production has been long developed, and biomass harvesting for fuel reduction has been a common practice within managed forestlands in Northern California. Biomass production, since the late 1980"s, not only provides economic support at the local, state, and federal levels but also reduces the nation's dependency of fossil fuels. The watershed also contains thousands of acres of chaparral, which produce a significant amount of renewable biomass, and although only a small portion of the biomass produced from chaparral landscapes is utilized for biomass.

The potential for biomass production within the Cottonwood Creek Watershed is good given that the watershed contains a substantial amount of raw material (chaparral and forestland species). In addition, the watershed is located within close proximity to a 50-megawatt wood-fired power plant, Wheelabrator Shasta Energy, in Anderson, which utilizes one hundred semi truckloads (~1,400 bone dry tons) of biomass each day, seven days/week, to produce electricity (Jolley 2002). There are other wood-fired power plants in Shasta County, but this facility is the closest to the Cottonwood Creek Watershed.

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, moisture, 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 transport van, moisture content of the fuel, 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 is a real value and should be considered 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.

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 contractor 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 XII 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 chips which are typically left on the ground. Brush may also be

Biomass collection in action. Tub grinder on right, conveyor takes biomass into the van.

mechanically removed and fed into a grinder for biomass production. Mechanical treatments are also utilized on industrial and non-industrial timberlands in which 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 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, as a means 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 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.

Pursuant to the California Forest Practice Rules, if biomass operations involve the harvest of commercial species, the project requires a permit issued by the California Department of Forestry and Fire Protection. Biomass operations which do not involve 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 biomass 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 biofule 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.

E. MAINTENANCE TREATMENT

Periodic maintenance of a fuelbreak sustains its effectiveness. Seeding the fuelbreak 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. There are several methods to maintain fuelbreaks.

1. Herbicides

The use of herbicides is a very effective method of eliminating unwanted vegetation, but there are many restrictions. Some herbicides are species specific, which means they can be used to eliminate brush species and will not harm grass species. Manual treatment is also a very effective means to eliminate invading vegetation, but is very labor intensive. The cost of fuelbreak maintenance must be balanced with its degree of effectiveness. The recommended rotation time to control sprouting regrowth and encourage the maintenance of ground cover by prescribed burning is 4 to 7 years (Schimke and Green, 1970).

2. Dozer Lines

The use of dozer/disc trails parallel to roadways is a common method to create a firebreak for ranchers in the north state. The firebreak is normally scraped, dug, bladed, or disced to mineral soil and provides a control point from which firefighters can work. Dozer lines are not aesthetically pleasing, but on a ranch are very effective.

3. Herbivores

Herbivore (goat) grazing may be used as a means of maintaining fuelbreaks, since goats would rather eat brush and weeds than grass. 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. Eliminating the ladder fuels helps prevent soil erosion and enhances rainfall infiltration. Monitoring of the herbivore grazing is critical since over-grazing can lead to erosion.

As goats work through an area they are also working on the understory, old pine needles and leaves, breaking lower branches, and splitting 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, CAL FIRE, DFG, and others.

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, Rickerby, CA. They report the vegetation in the Sierra Foothills grazing area consists of woody plants, shrubs, forbs, and grasses. Before entering a new area, they develop a landscape goal, complete a vegetative survey, and identify toxic plants. They identify the growth habit and adaptation of each plant specie, 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.

Herbivores Used In Fuel Reduction

4. Converting Brush Land to Oak Woodland

Brush land usually occurs on soils that are best suited for growing brush. 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, but can include such species as chamise, Lemon's ceanothus, buckbrush, toyon, poison-oak, whiteleaf manzanita, and western mountainmahogany. 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 will entail 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.

X. 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 fuelbreaks. Roadside fuelbreaks not only provide defensible space for firefighters, but also a safe escape route for residents in the event of a wildfire.

For this plan, the roads in the Cottonwood Creek Watershed have been classified into two groups: main roads, which are state routes or major county arterial roads, and secondary roads, which access neighborhoods, rural areas, forest zones, and ranch areas. The secondary roads have also been grouped by compass location within 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 options.

In the eastern section of the Cottonwood Creek Watershed, road concentrations are in the developing areas near Bowman Road, Gas Point Road, and Happy Valley Road. In the western portion of the watershed, there are many forest access roads onto public and private forest land. Ranch roads dominate the central and foothill portions of the watershed. Many of the private ranch roads are gated and locked.

Roads names with main road vs. secondary road, compass groupings, and county are as follows:

TABLE 5
COTTONWOOD CREEK WATERSHED ROADS

ROAD	COMPASS GROUPING	COUNTY
MAIN		
Interstate 5	N/S	Shasta (S)/ Tehama (T)
State Hwy 36	E/W	S/T
Platina Road	SW/NE	S
Bowman Road	E/W	T
SECONDARY - NORTH		
Bland Road	SW/NE	S
Bully Choop Road	N/S	S
Duncan Creek Road	SE/NW	S
Fiddler's Road	SE/NW	S
McAuliffe Road	E/W	S
Rainbow Lake Road	E/W	S
Roaring Creek Road	E/W	S
South Fork Road	E/W	S
Sunny Hill Road	Loop	S
SECONDARY - WEST		
Beegum Gorge Road	SW/NE	S
Cow Gulch Road	SW/NE	S
Deer Lick Knob Road	N/S	S
Deer Lick Springs Road	N/S	S
Forest Route 41	SE/NW	T
Forest Route 45	E/W	T
Harrison Gulch	N/S	S
Pattymocus Road	E/W	T
Tedoc Gap Road	N/S	T
White Rock Road	SW/NE	S
SECONDARY – SOUTH		
Ball Road	N/S	T

ROAD	COMPASS GROUPING	COUNTY
Forest Route 26N01	N/S	T
Forest Route 35	N/S	T
Hammer Loop Road	Loop	T
Pettyjohn Road	E/W	T
Vestal Road	E/W AND N/S	T
Weemasoul Road	N/S	T
SECONDARY – EAST		
Balls Ferry Road	SW/NE	S
Basler Road	SW/NE	T
Benson Road	SW/NE	T
Cannon Road	SW/NE	T
Evergreen Road	E/W	T
Farquhar Road	N/S	T
Gas Point Drive	SE/NW	S
Happy Valley Road	N/S	S
Hooker Creek Road	E/W and N/S	T
Kingsland Way	E/W	S
Lake California Drive	E/W	T
Lower Gas Point Drive	N/S	S
Luce B Griswold Road	N/S	T
Matlock Loop	Loop	T
Quail Ridge Road	SW/NE	T
Squiss Drive	SE/NW	S
West Anderson Drive	N/S	S

XI. POTENTIAL FUNDING SOURCES

The following table lists various cost share programs as provided by the University of California, Cooperative Extension Service (UCCE).

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	Cost sharing, technical and educational	Up to 75% set by local working group	NRCS, FSA	Agricultural producers having significant natural	Approved practices up to $10,000 per producer per year.

Program	Goals	Services	Will Fund	Agency	Who	Limitations
	objectives	assistance			resource needs	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.	CAL FIRE	RCDs, RC&Ds, special districts, Indian tribes, and community non-profit organizations.	Projects that involve 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 create	Covers liability, conducts prescribed burn	Up to 90% cost share	CAL FIRE	Landowners, individual or group	Agreement to sign, plan required

Program	Goals	Services	Will Fund	Agency	Who	Limitations
	wildfire hazards.					
California Forest Improvement Program	Forestry, watershed and riparian protection and enhancement	Reforestation, site prep, land conservation, and fish & wildlife habitat improvements	75% up to $30,000 per contract, rehab after natural disaster up to 90%	CAL FIRE	Landowners	Plan (can be cost shared) required, 20-50,000 acres of forestland

Additional funding sources include:

- **C**alifornia Department of Conservation, RCD Assistance Program
- USDA Forest Service State Fire Assistance (SFA)
- Shasta County Regional Advisory Committee, Title II Funds, Secure Rural Schools and Community Self-Determination Act of 2000
- Bureau of Land Management (BLM) Community Assistance
- National Park Service (NPS) Community Assistance/WUI
- U.S. Fish and Wildlife Service (USFWS) Wildland-Urban Interface Grant Program
- California State Fire Safe Council Clearinghouse, Fuel reduction project grant funding
- Tehama County Regional Advisory Committee, Title II Funds, Secure Rural Schools and Community Self-Determination Act of 2000

XII. FUELBREAK MAINTENANCE FUNDING

Since grant funds are often obtained just to construct the fuelbreak, maintenance efforts are often left to the landowner. Unfortunately, some landowners do not have the physical or financial means to do maintenance. If a fuelbreak 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 4 above also provide

funding opportunities for fuels reduction and maintenance. Future legislation, such as AB 1983, may also provide funding for fuels reduction projects.

California Assembly Bill AB 1983 was introduced by Assembly Member Dickerson on February 14, 2002. The bill would enact the **California Fuel Hazard Reduction Act** to be administered by the California Department of Forestry and Fire Protection (CAL FIRE), in consultation with the Department of Food and Agriculture, to encourage the development of wildland fuel reduction practices. The bill would establish the Fuel Hazard Reduction Fund in the State Treasury to fund the program. CAL FIRE would be authorized to spend up to 5% of the fund balance for program administration and wildfire cost collection. The bill would authorize 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 establish 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 establish 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. As of this writing, the 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.ceres.ca.gov/foreststeward/funding.html
- www.ice.ucdavis.edu/
- www.teleport.com/~rivernet/general.htm
- www.tpl.org/tpl/about/
- www.ufei.calpoly.edu/data/news/grants.html

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

XIII. GRANT FUNDING OPPORTUNITIES

Funding sources are as varied as the projects listed above. The Cottonwood Creek Watershed Group has the organizational structure to seek funding for any projects generated through this Plan. There are several sources of funding available through the agencies in the area, discussed in Sections X and XI of this plan.

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APPENDICES

APPENDIX A: GLOSSARY
APPENDIX B: COMMUNITY FIRE SAFE FUEL REDUCTION GUIDELINES

APPENDIX A
GLOSSARY

BEHAVE – A computer program used for predicting fire behavior.

Chain – A unit of measurement equal to 66 feet.

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 Fuelbreak – 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.

APPENDIX B

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

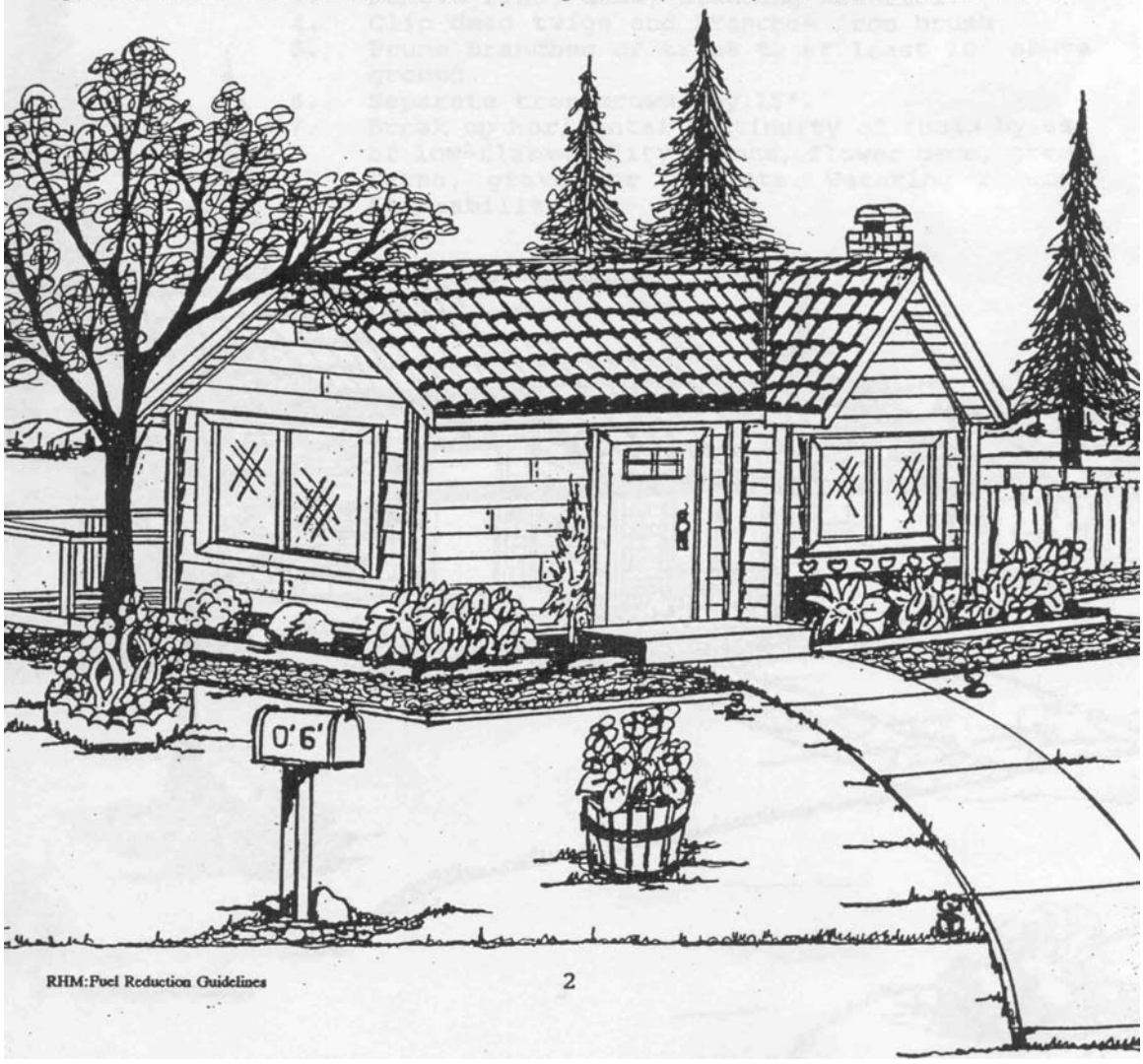
1. The Home Zone 0' to 6'

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'

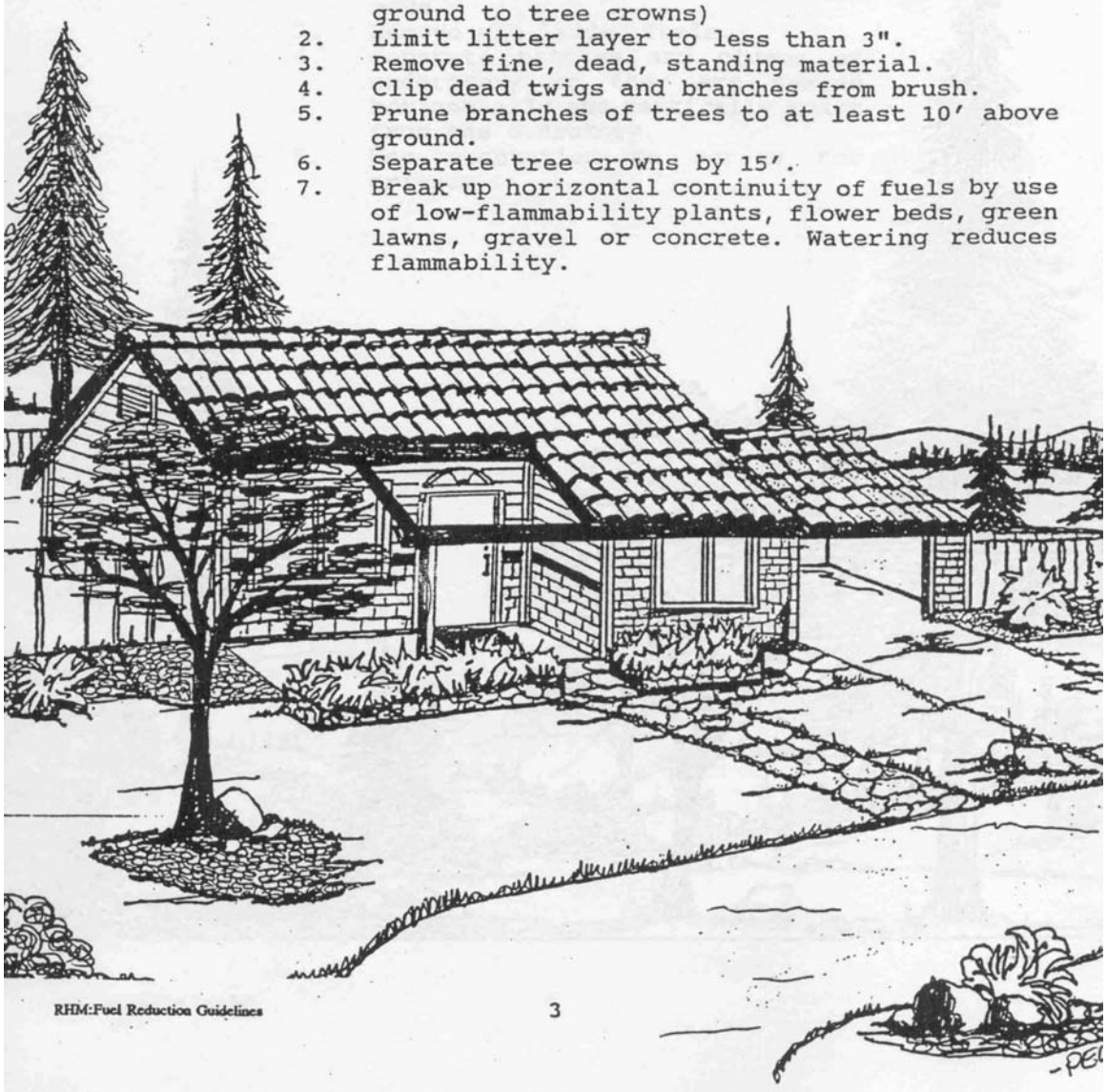
GOAL: To prevent a fire from moving from ground fuels to brush or tree crowns and to slow the rate of fire spread.

> 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.



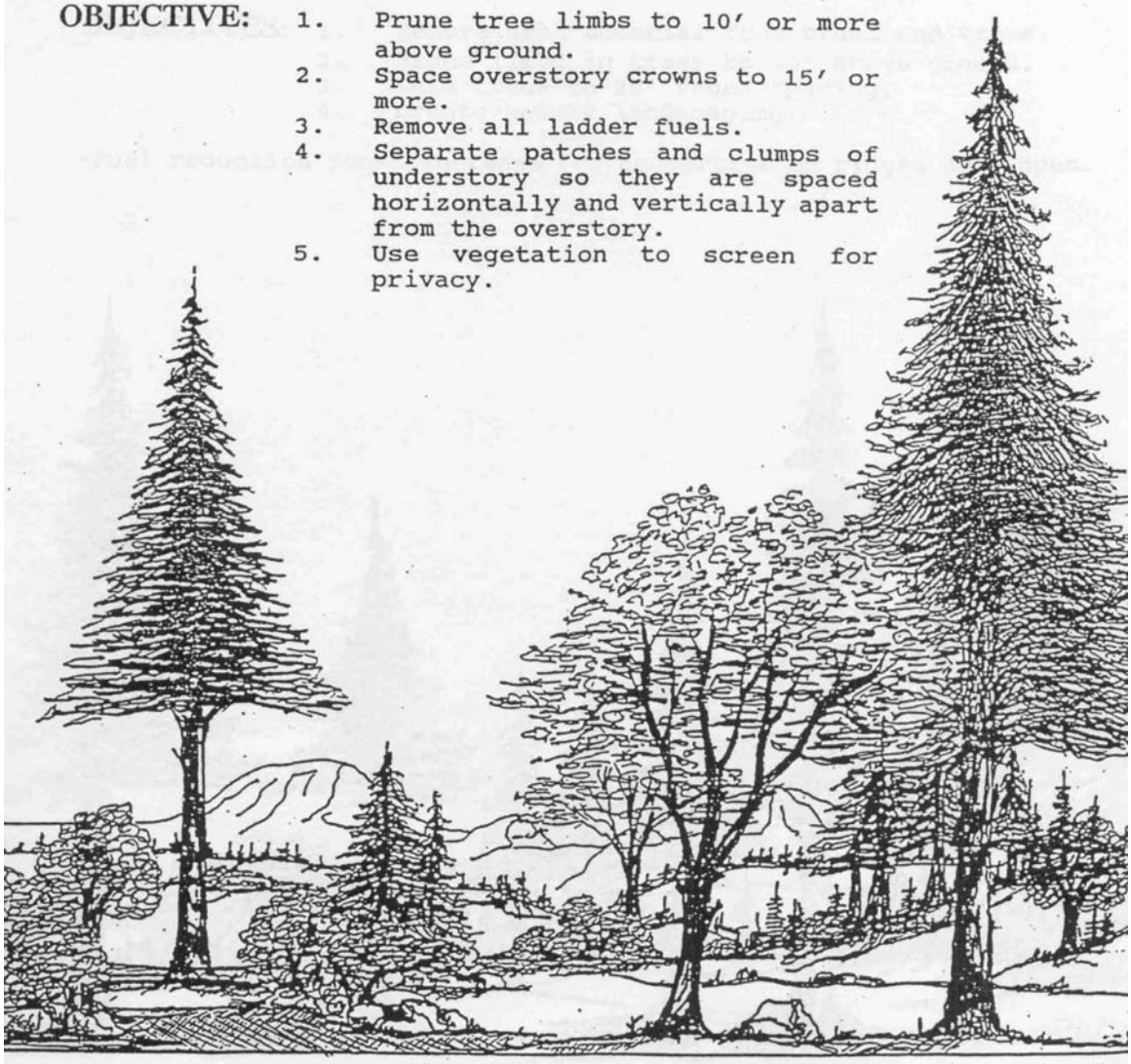
3. The Brush / Screen Zone 30' to 75'

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'*

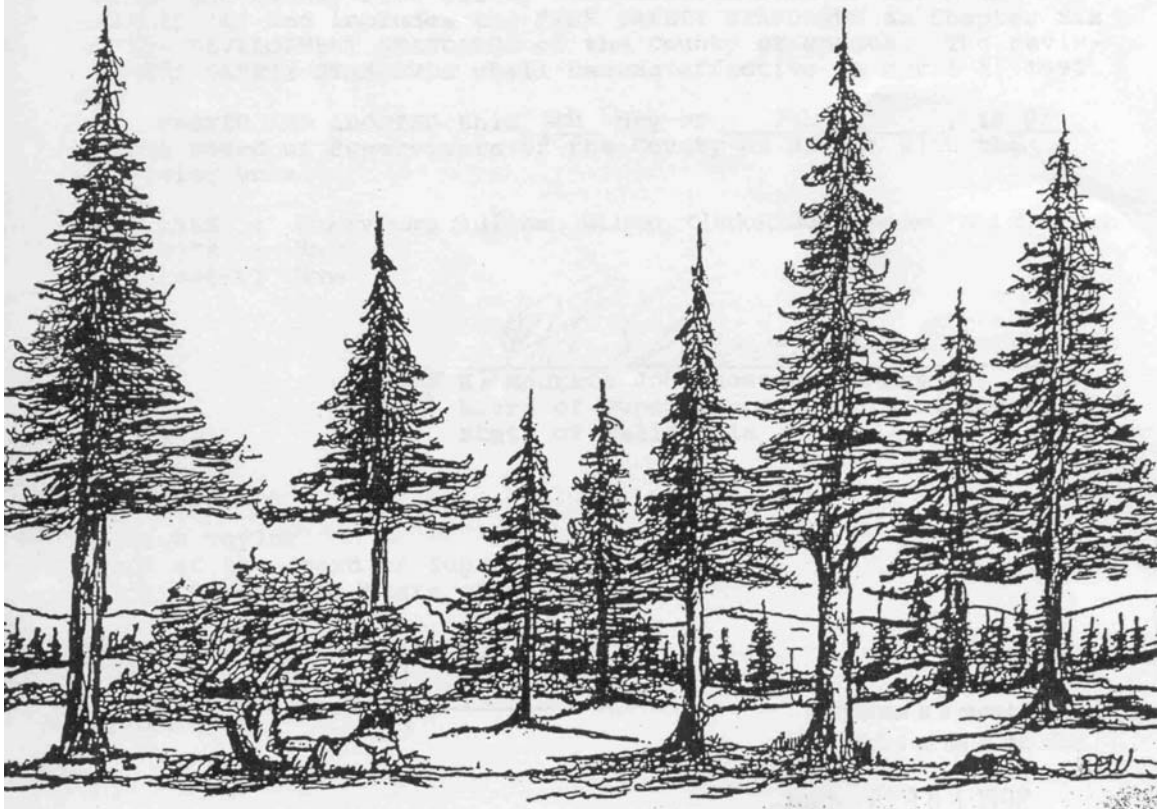
GOAL: To provide a space in which a fire will "cool down, slow down and stay on the ground" thereby maintaining fire safety in forest communities.

[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.



MAPS

1. COTTONWOOD CREEK PLANNING AREA
2. FIRE SEVERITY RATING
3. VEGETATION
4. SPECIAL STATUS SPECIES & HABITAT
5. FIRE HISTORY

6-6b. PROPOSED PROJECTS