Chapter 4

Assets at Risk

Introduction

The primary purpose of wildland fire protection in California is to protect the wide range of assets found on California wildlands. These assets include life and safety; timber; range; recreation; water and watershed; plants; air quality; cultural and historic resources; unique scenic areas; buildings; and wildlife, plants, and ecosystem health. This section briefly describes these assets and discusses approaches to assessing their economic and non-economic values.

Knowledge of the types and magnitudes of assets at risk to wildfire, as well as their locations, is critical to fire protection planning. Given the limits on fire protection resources, these resources should be allocated, at least in part, based on the value of the assets at risk.

This analysis addresses two basic questions: What are the aggregate values of the assets at risk to wildfire? What are the losses, both economic and non-economic, in a fire? Where possible, estimates of values were made on a dollar-per-acre basis. The methodologies used, although exposed to some peer review, need further review and refinement that is part of the pilot projects in the three ranger units. Also, CDF is working with the Department of Fish and Game, State Water Resources Control Board staff, Department of Water Resources, USDA Forest Service, Los Angeles Flood Control District, Pacific Gas & Electric Co. and the East Bay Municipal Utility District and other stakeholders to refine our approaches to wildlife, plants, ecosystem health, watersheds and water.

The fire plan assessment framework will use three key techniques to relate each asset being protected to existing and potential levels of service and resource allocation priorities.

There are three key techniques for assets at risk: GIS maps, community meetings to validate assets and joint CDF/stakeholder funding.

- As reflected in the prefire management process descriptions in the appendix, CDF headquarters staff has developed GIS maps on assets at risk. From this data, CDF will produce ranger unit maps with overlays for each commodity and non-commodity asset protected. Each asset map will indicate whether the preliminary value of the asset in a given area is high, medium or low. These maps will be reviewed and refined at the ranger unit level.

- Separate community level meetings will be scheduled with the respective stakeholders for each asset at risk. The purpose is to acquaint the stakeholders with the process and to bring their expertise and knowledge to bear on the asset maps. In effect the stakeholders will be asked to evaluate the preliminary rankings for levels of service based on economic and non-economic values. This process provides a sort of Delphi technique of using expert and asset owner judgments where quantifiable data is not available
- CDF also will engage stakeholders in a process to identify who is willing to invest prefire projects that will protect the various assets. CDF's major reason for conducting prefire management projects is to reduce state suppression costs and disaster relief. Thus, CDF will allocate its state prefire project funds primarily on the basis of projects' potentials to reduce the suppression and state disaster funding costs that would occur in the project area under high-hazard fire conditions. However, where stakeholders are willing to provide funds to support prefire projects that would reduce the threat to assets at risk, CDF will consider undertaking such projects, even if the benefits in terms of reducing potential state suppression and disaster relief costs are less than might be achieved by other prefire projects competing for state prefire project funds.

Detailed explanation of the quantification and valuation approaches for each asset may be found in the appendix. The table, *Assets at Risk Framework Summary*, at the end of this chapter depicts the framework developed for estimating fire impacts. Resource assets presented here are air quality, range, recreation on public wildlands, structures, timber, water and watersheds, cultural and historic resources, unique scenic areas, and wildlife, plants and ecosystem health. No attempt was made to place economic value on the loss of human life or unique scenic areas, although there are methodologies for estimating such values. Their true value to society cannot be measured.

Assets may be of value locally, statewide or nationally.

For each resource, the assets at risk framework summarizes the asset value basis (i.e., the units in which fire impacts have been estimated) and the level of disaggregation (resource subtype and geographic area) of these values. The table also indicates the levels (local, state and national) at which the resources are valued. The manner in which "consumers" of a particular resource value it may differ from local to state to national levels. Some of the resources protected from fire in California even have international value. For example, the scenic Lake Tahoe Basin or the old growth redwood parks of the North Coast are considered of high value at the local, state and federal levels, as well as internationally.

The Lake Tahoe Basin, one of the state's most beloved natural resource assets, is facing extreme fire risks. (Photo courtesy of Department of Water Resources)

The rest of this section briefly discusses each asset at risk. (The appendix provides more detail.) It should be emphasized that calculations of economic assets are preliminary and often highly aggregated. The estimates will be refined as fire plan implementation moves to the ranger units

Air Quality

Air pollution from wildfires can affect, among other assets, visibility, human health, materials, vegetation, pollution rights and greenhouse gas accumulation. Quantifying impacts is difficult. First,there is insufficient data on the quantities of various pollutants that are emitted during wildfires of varying intensities burning in a wide range of fuels. Second, models of pollutant dispersion, though increasingly sophisticated, still leave much to be desired, particularly when trying to apply them to specific events rather than to longer-term emissions. Third, models estimating the impacts of various pollutant levels on human health have generally been geared toward examining chronic pollution levels, not episodic events such as wildfires. This area of empirical research has been almost ignored by the air quality agencies in California. There is an assumption that wildfires are "acts of God" and not manageable by man. However, this assumption is not true. As reflected in this fire plan framework, future wildfires are predicted and their losses, including levels of air pollutants can be managed before the fire occurs.

The estimated annual wildfire air pollutant emissions are 600,000 tons from CDF and USDA Forest Service fires.

As reflected in Appendix C, Table 3, the estimated annual wildfire air pollutant emissions are 600,000 tons from CDF and USDA Forest Service fires. This does not include Bureau of Land Management, Bureau of Indian Affairs, National Park Service or wildlands inside city limits fires. The estimated 600,000 tons of air pollutants annually are based on a ten year average of acreage burned by vegetation type annually. A joint initiative is needed between the Board of Forestry and the Air Resources Board to reduce air emission pollutants from wildfire. Estimates of air quality wildfire impacts have been developed for particulate matter, specifically PM10 (particulates 10 microns or smaller). Using economic impact models developed for the California Energy Commission combined with basic fuels and emissions models, dollar-per-acre estimates for air quality impacts were developed for 13 of the state's 14 air basins. For some basins, where industries can buy and sell rights to emit PM10 pollution, the value of these rights is also included. It should be noted that the Energy Commission models are not widely accepted. The wildfire air quality impact values estimated range from $1 per acre to $15,000 per acre burned, depending upon the fuel type and the air basin. While these estimates include some measure of all of the above air quality related values, there are additional non-commodity values that are not well represented (for example, air quality impacts to areas of unique scenic quality).

The overall strength of the methodology used to develop these estimates is uncertain. The base air pollution impact model used is not widely accepted. Further, estimates of pollutants released from the open burning of given fuel types and loadings are not well researched and are highly generalized. This is an area needing more research by the local, state, and federal air quality and wildfire protection agencies.

Range

Range is primarily vegetation as forage, estimated to be worth $138 million a year in California. The value of forage lost to fire is based on the cost of replacing that forage for two years through feeding oat hay or alfalfa to the livestock. It was assumed that the probability of an acre of rangeland burning is the same whether it is grazed or not. Ungrazed acres were assumed to have a zero replacement feeding cost. To calculate an average loss per acre burned, averages were developed of replacement feeding costs per acre by type of grazed rangeland as a percentage of all grazed and ungrazed acres.

Rangeland types and associated replacement feeding costs were disaggregated to eight regions, nine cover types and five ownership classes, allowing a fairly detailed analysis of fire impacts. At the fully disaggregated level, replacement feeding cost estimates ranged from zero to $114 per acre of rangeland burned. The weighted average cost statewide is estimated at $8 per acre.

Recreation on Public Wildlands

Fire adversely affects recreation values on public and private land alike; however, the lack of data regarding recreation on private lands allows estimates only for public lands. The bulk of recreation on public wildlands occurs in national parks and forests, Bureau of Land Management holdings and state park lands. Recreation on public wildlands in recent years averaged an estimated 112.1 million recreation visitor days per year. A recreation visitor day (RVD) is equivalent to 12 hours of participation in any recreation activity. Based on USDA Forest Service data, the estimated average market value is $13.26 per RVD for wildland recreation in the state.

Based on this conservative value, an annual average value of $1.5 billion per year for recreation was calculated for public lands in the state. The impacts of wildfire on recreation values were estimated to range from $5 per average acre burned (for the Bureau of Land Management) to $107 per average acre burned (for the state parks system). Of course, where the areas that burn are particularly scenic, visible, or accessible to the public, the value impacts will be significantly greater.

Structures

Statewide, approximately one million housing units are within California's, including wildlands and wildland-urban interface areas. In total, these housing units have an estimated replacement value of $107 billion for the structures only. Based on fire records for 1985-94, an estimated 703 homes are lost annually to wildfire in California. Taking into account the value of dwellings, value of contents, other improvements, intangibles, uninsured losses, costs of disruption (lost wages, temporary housing, etc.) and insurance company transaction costs, the average loss per home burned from

Average annual home losses to wildfire is $163 million.

wildfire is estimated to be $232,000. Average total annual loss of California homes to wildfire is estimated at $163 million.

Timber

The timber assets at risk represent the economic value of standing trees for conversion to wood products, such as lumber. Trees that will not be converted to wood products, such as those found on areas administratively or congressionally designated as wilderness, do not have timber value. Timber values were estimated using USDA Forest Service statewide inventory data and stumpage values determined by the State Board of Equalization. The estimates were disaggregated to six regions or cover types and four ownership categories.

Using this approach, the standing value of California commercial timber is estimated to be $105 billion. The timber value lost during a wildfire depends on the intensity of the fire. For a moderately intense, stand-replacing fire, it is estimated that the timber value lost will range from $2,538 per acre in the northern interior to $8,823 per acre on the central coast, based on assumptions about volume loss and salvage values. Less intense or more intense fires would cause different levels of loss.

Water and Watersheds

Water and watersheds have both commodity values and broad environmental values. As a commodity, water produces electrical power and quenches the thirst of people, industry and agriculture. Water impounded behind dams also provides important recreational opportunities. As an environmental resource, water sustains plants, animals and aquatic ecosystems. The many benefits of water are referred to as “beneficial uses.” The six million acre feet of water delivered annually to residential, commercial and industrial consumers have a retail value approaching $6 billion. The 24 million acre feet of water used by agriculture each year have a value of about $1.5 billion. In an average year, California produces about 40,000 gigawatt-hours of hydroelectric power with a value of approximately $1.6 billion. In-stream uses of water for maintaining aquatic ecosystem function have a huge but incalculable value as well.

Fire can have beneficial and detrimental watershed impacts.

Fire can have beneficial and detrimental effects on water and watersheds. By removing vegetation and exposing mineral soil, fire impairs the ability of a watershed to hold soil in place and to trap sediment. As a result, increased amounts of sediment are delivered to streams, reducing both commodity and non-commodity beneficial uses. On the other hand, by decreasing evapotranspiration, fire can increase, at least on a temporary basis, the quantity of water delivered to streams. However in the wrong place at the wrong time — such as the fire-flood cycle commonly experienced in Southern California — this increased run-off and its large sediment load causes costly damage to downstream assets such as homes, roads, debris basins and other infrastructure.

The actual water and watershedeffects that result from a wildfire vary greatly depending upon the size and severity of the fire, vegetation type, soil type, slope, proximity to a watercourse and other factors. Only a few general conclusions are drawn here regarding the economic impacts of fire on water and watershed resources. Large, intense wildfires can produce increased runoff worth from $3 to $12 per acre burned in the year after the fire. In addition to consumptive uses, this additional runoff can generate hydroelectricity. In one hypothetical example, $17.50 worth of hydroelectricity would be produced per acre burned in an intensive wildlife enhancement project during the first year after the fire. The value resulting from increased runoff will diminish rapidly as the burned area revegetates over the years following the fire. Fire-caused sedimentation can diminish reservoir capacity, costing $9 to $90 per acre burned in a large, intense fire. This risk is more imminent in reservoirs without large amounts of dead storage capacity, typically smaller reservoirs and reservoirs not originally designed to produce hydropower. Sediment removal after such a fire could cost $100 toas much as $1,000 per acre burned. Increased sedimentation also causes additional wear and tear on hydroelectric generation equipment, harms fisheries and has negative aesthetic impacts; none of those effects can be quantified easily. Fire and landslides triggered by lost vegetation are direct threats to water supply and hydro facilities, such as flumes borne on wooden trestles and canals on hillsides. Then there is the expense of watershed rehabilitation, such as reseeding or replanting vegetation or installing erosion controls: Reseeding grasses afterwildfire costs $30 to $200 an acre; planting tree seedlings costs about $200 per acre.

Sediment removal after such a fire can cost $100 to as much as $1,000 per acre burned.

Overall, it is clear that the economic costs of intense wildfire impacts on water and watershed are greater than the benefits derived from increased water flow. CDF is working with the State Water Resources Control Board staff, Department of Water Resources, USDA Forest Service, Los Angeles Flood Control District, Pacific Gas & Electric Co., the East Bay Municipal Utility District, and other stakeholders, to improve these preliminary characterizations and valuations of water and watershed impacts.

Wildlife, Habitat, Plants, and Ecosystem Health

One of the more challenging categories of assets at risk covers wildlife, habitat, plants, and ecosystem health. First, it is difficult to develop economic values for these assets. A number of economic techniques can be applied,but they are often expensive and subject to significant limitations. This difficulty arises in large part because of the ways in which these assets are valued. Aesthetic values in particular do not appear in a market form and are difficult to quantify, let alone determine a per-unit value. Second, fire can have markedly different effects on wildlife, habitat, plants, and ecosystem health. Large fires do not burn evenly and as a result produce a mosaic of vegetation and postfire plant community succession. Alternatively, at a smaller scale, an intense stand-replacing fire can reduce habitat heterogeneity and foster a uniformity of food and cover value

particularly in areas of similar slope, aspect and soil type. Both outcomes may be positive, negative, or exhibit no particular effect depending on the degree of habitat patchiness, the wildlife and plant species of concern, and other topographic, climatic and biological variables influencing fire effects. Thus, consistent generalization of the effects of postfire habitat conditions and their implications for wildlife, habitat, plants, and ecosystem health is not yet possible. An individual species may be favored, negatively affected, or exhibit no particular response to the postfire environment.

While wildfire-caused modification of one habitat type into another may in many cases be "value-neutral," in other cases, such as the loss of habitat for a threatened or endangered plant or animal species, we may be very concerned about conversion of habitat type. One key example here is the California spotted owl, which the USDA Forest Service has identified as a sensitive species. Scientists have identified wildfire and its potential impacts on the species' mature forest habitat as one of the biggest threats to the owl.

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Long-lasting negative effects of a wildfire in present day fire regimes are likely limited to:

- Localized stream habitats, late seral or climax forest habitats sensitive to fire effects and requiring long periods before re-establishment.
- Some seral habitats that through direct and indirect fire effects do not effectively regenerate.
- Areas occupied specifically by species with unstable populations that are negatively affected by fire occurrence.

Overall, it is not yet possible to specify both the biophysical and economic ramifications of the interactions between wildfire and wildlife, habitat, plants, and ecosystem health. A number of experts have indicated, however, that when one considers qualitatively the economic effect of wildfires on all species, fire regimes and wildland habitats at the scale of the state, it is likely that fire, at least over the short term, has had a net neutral if not beneficial effect. On the other hand, specific fires in specific places at specific times can have significant adverse impacts on particular plant or animal species and/or their habitat. Given the dynamic nature of vegetation, wildlife populations and ecosystems, these impacts are of the greatest concern for listed species, those near the lower bound of population viability.

Other Resource Values

Other, significant resource asset values have not been addressed above. These include historic resources, such as very old structures or places where important events occurred, and cultural resources, such as archaeological sites and unique scenic resources, such as Yosemite National Park or the Lake Tahoe Basin.

California has 85,000 recorded historic buildings, most of which are located in wildland areas. There are over 100,000 recorded archaeological sites in California. It is estimated that there is a like number of undiscovered or unrecorded sites in the state.

Historic and cultural resources cannot easily be valued economically since they are not generally exchanged in the market and are often unique. Further, many people get satisfaction simply from the knowledge that these resources exist and are being protected in perpetuity ("existence" and "bequest" values in the terms of economics), regardless of whether they will ever visit them personally. Similar considerations apply to unique scenic resources. These special resources may have value to people at the local, state, national and even international level, adding further difficulty to attempts to place an economic value on them. Measuring recreation values of the actual usage of unique, scenic areas captures only a small part of their total value to society.

Assets at Risk Framework Summary

esource	Asset Value Basis	Level of Disaggregation	Levels of Value*	Strength of methodology
fe and safety	Non-economic values are not quantified	By population density	National, state and local	High
r quality	Non-economic values of pollutants; average dollar impact from particulate matter (PM10) emitted per acre burned	Air quality basins (13), basic fuel types (2), and by air pollutant emissions	National, state and local	Low
ange	Dollar cost of replacement feed per acre of rangeland burned	Values by regions (8), cover types (9) and ownership classes (5)	State and local	High
ecreation on ublic wildlands	Average dollar loss per acre burned; non-commodity assets also exist	Statewide average by public ownership categories (5)	National, state and local	Low
ructures	Average dollar loss per home burned; non-commodity assets also exist	Statewide average	State and local	High
mber	Average dollar loss per acre burned	Values by regions (6) and ownership categories (4)	National, state and local	High
ater and atersheds	Range of economic impacts per acre for value of increased water yields; cost of sediment removal; loss of reservoir capacity; effects on hydroelectric generation; costs of watershed rehabilitation; non-commodity assets also exist	Statewide ranges of economic impacts	National, state and local	Low to medium
ildlife, habitat, ants and osystem health	Qualitative discussion of the tradeoffs in fire impacts	Statewide	State and local	Low
ther resource ssets, cultural nd historic sources, unique enic areas	These non-commodity assets cannot be quantified adequately; descriptive enumeration only	Statewide (generically) or place-specific	National, state and local	Low to medium

*May or may not be cumulative.