# PROTECTING CULTURAL RESOURCES FROM FIRE AND FIRE MANAGEMENT ACTIVITIES:

# THE CULTURAL RESOURCE ELEMENT FOR REDWOOD NATIONAL PARK FIRE MANAGEMENT PLAN

By

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Cultural Resources Management

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Date: 12/13/2010

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**ABSTRACT**

Purpose of the Study:

The document on which this thesis is based was created under the terms of a cooperative agreement between the National Park Service (NPS) and Sonoma State University (SSU) to create a cultural resource appendix to the Fire Management Plan (FMP) of Redwood National and State parks (RNSP). The NPS is currently in the process of updating the RNSP FMP and Environmental Assessment (EA) that was originally prepared in 2004. This plan addresses activities related to fuels management, prescribed burning, and wildland fire suppression. The park's existing 5 year FMP and EA will be expanded to include new fuel treatment areas within the park and will address any new national fire management policies that have been adopted since the original FMP.

A confidential cultural resource appendix to the FMP is needed to identify: historic property types found at the park, fire program impacts related to fuels management activities and wildfire suppression, proposed programmatic actions needed to identify historic properties, and how NPS proposes to negate or minimize potential adverse effects to historic properties eligible for or listed on the National Register of Historic Places (NRHP).

The cultural resource appendix on which this thesis is based will be used as an appendix to the FMP and is also intended to assist NPS to develop a Programmatic Agreement (PA) with the California State Historic Preservation Officer (SHPO) to stream-line the National Historic Preservation Act (NHPA), Section 106 process under implementing Federal Regulations 36 CFR 800.14 (Federal Agency Program Alternatives). Federal land managing agencies are required to consider the effects that their proposed actions have on properties listed in, or determined eligible for inclusion in the National Register of Historic Places (i.e., historic properties), and allow the Advisory Council on Historic Preservation (ACHP) a reasonable opportunity to comment (NHPA, as amended). Agencies are required to consult with Federal, state, local, and tribal

governments/organizations and the public to identify historic properties, assess adverse effects to historic properties, and negate, minimize, or mitigate adverse effects to historic properties while engaged in any Federal or federally assisted undertaking (36 CFR Part 800). Federal land managing agencies can streamline this process for undertakings that have the same potential impacts on the same types of historic properties in a programmatic fashion under Subpart C (Program Alternatives) of the implementing NHPA, Section 106 regulations (36CFR800.14).

Procedure:

An extensive literature review based on fire behavior, the effects of fire on cultural resources, and on fire management practices was conducted and compiled to form the basis for this thesis. After the literature review was completed, a comprehensive guide of information and recommendations for the NPS was written to aide in the avoidance of adverse effects to cultural resources during wildfires, prescribed fires, fuels management, and other fire management activities.

Findings:

This thesis presents the results and conclusions based on the literature concerning the prehistoric cultural context, the historic-era context of logging and sheep ranching in RNSP, the direct effects of fire on cultural resources from fire and fire management activities, as well as the indirect and operational effects due to the same fire related activities. This report offers recommendations to the NPS for the compliance with federal law and the protection of cultural resources during fire and fire management activities. Finally, this report features three matrices to be used by the NPS in order to aid in the quick assessment to the types of damage and risk for specific cultural materials and resources which can occur during fires in three separate fuel types: 1) grassland, 2) brush, and 3) timber.

Chair: 12/13/2010

Adrian Praetzellis, Ph.D. Date:

M.A. Program: Cultural Resources Management

Sonoma State University

ACKNOWLEDGEMENTS

A master's thesis acknowledges the research and writings of the author, however this master's thesis was not the accomplishment of one person, but was completed through the generous help, guidance, and support of many others. Several people must be recognized for their contributions and help not only for this work, but for the original report for Redwood National and State parks (RNSP) which formed the basis of this thesis, as well as others who have encouraged and supported me during my time and hard work at Sonoma State University.

Adrian Praetzellis and all of his staff at the Anthropological Studies Center (ASC) were exceptionally helpful and instrumental from the inception to completion of the document provided to RNSP. Through the guidance of Adrian Praetzellis along with the editors and producers, this original report was professionally completed for the NPS in October 2009. A special thanks to Mary Praetzellis, Mike Newland, Jan Coulter, Kate Erikson, and others who have helped out with this project.

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Finally, I would like to dedicate this work to my dad, Jack Edward Allen, who has consistently supported and encouraged me to stick with this and get it done. Many thanks Dad!

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# CHAPTER 1. INTRODUCTION AND REGULATORY FRAMEWORK

## PURPOSE

The document on which this thesis is based was created under the terms of a cooperative agreement between the National Park Service (NPS) and Sonoma State University (SSU) to create a cultural resource appendix to the Fire Management Plan (FMP) of Redwood National and State Parks (RNSP). The document required pulling together a wide variety of sources including federal law and regulations, the cultural context and resources located with the boundaries of RNSP, fire management plans, policies, and operations for RNSP, the effects of fire on cultural resources, Fire Management units (FMUs), as well as original research which yielded the matrices found in the appendix. These matrices are designed for use by RNSP to help fire personnel avoid adverse effects on cultural resources in three separate fuel types (grass, brush, and timber/woodland).

The NPS is currently in the process of updating the RNSP FMP and Environmental Assessment (EA) that was originally prepared in 2004. This plan addresses activities related to fuels management, prescribed burning, and wildland fire suppression. The park's existing 5 year FMP and EA will be expanded to include new fuel treatment areas within the park and will address any new national fire management policies that have been adopted since the original FMP.

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## LOCATION AND DESCRIPTION

The headquarters for RNSP is located in Crescent City, California. The park encompasses the western parts of both Humboldt and Del Norte counties. Park access varies and is located along Highway 101 on both the west and east sides of the highway (Figure 1).

Together Redwood National and State parks (RNSP) cover more than 106,000 acres of lands in northwestern California reaching from the shoreline of the Pacific Ocean to the Coast Range. The parks include a mosaic of vegetation types that are susceptible to wildland fires to varying degrees. Old growth redwood forests, grasslands and oak woodlands, coastal strand and Sitka spruce forests, and dry pine woodlands are all represented in the parks, as well as about 50,000 acres of second growth forests in all stages of re-growth after being logged prior to park establishment. The parks are bordered by private property, including both rural and more urbanized residential and commercial properties, and industrial timberlands. Wildland fires in any of these vegetation types can endanger human life, damage park resources, and destroy private property (RNSP FMP 2004:1).

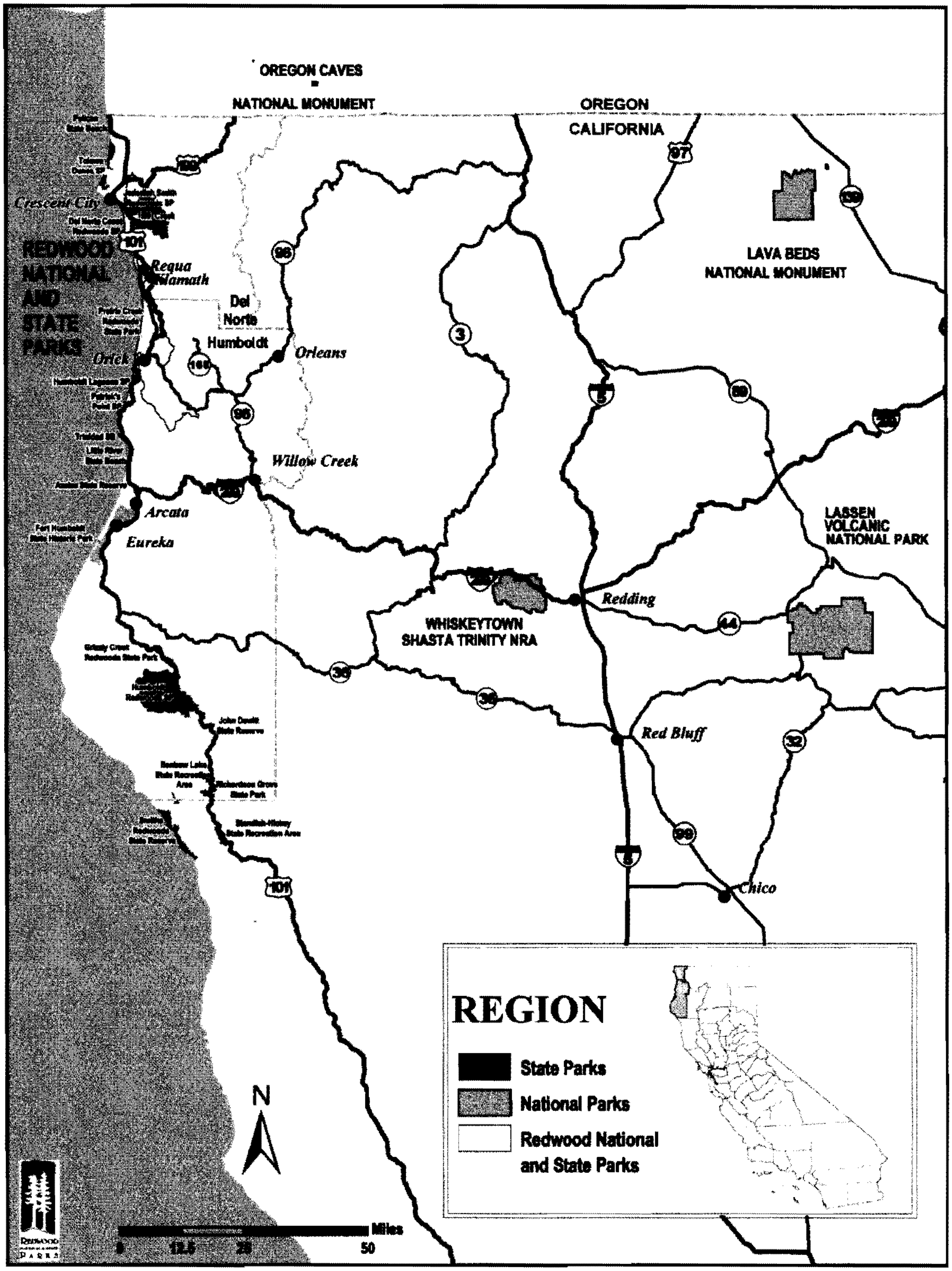


Figure 1. Project location map (NPS 2004)

## REGULATORY FRAMEWORK

The following section outlines the principal federal laws, regulations within which this FMP will operate.

### National Register of Historic Places (NRHP)

The NRHP is the nation's master inventory of cultural resources worthy of preservation. It is administered by the National Park Service, which is represented at the state level by the State Historic Preservation Officer (SHPO). The National Register includes listings of buildings, structures, sites, objects, and districts that possess historic, architectural, engineering, archaeological, or cultural significance at the federal, state, or local level.

Eligibility for listing on the NRHP is determined by applying the Criteria for Evaluation at 36 CFR 60.4:

> The quality of significance in American history, architecture, archaeology and culture is present in districts, sites, buildings, structures, and objects of state and local importance that possess integrity of location, design, setting, materials, workmanship, feeling and association, and:
>
> a. that are associated with events that have made a significant contribution to the broad patterns of history; or
>
> b. that are associated with the lives of persons significant in our past; or
>
> c. that embody the distinctive characteristics of a type, period, or method of construction, or that represent the work of a master, or that possess high artistic values, or that represent a significant and distinguishable entity whose components may lack individual distinction; or

d. that have yielded or may likely yield information important in prehistory or history.

Effects on properties that are listed on or eligible to NRHP must be considered by federal agencies as part of the NEPA process.

**National Environmental Policy Act (NEPA)**

The purpose of NEPA is to protect the natural environmental and cultural resources from adverse effects during a federal undertaking. The undertaking can be defined by any project that is partially or fully funded by the U.S. government. Federal and federally assisted projects are subject to NEPA (PL 91-190) whose goal is, in part, to "preserve important historic, cultural and natural aspects of our national heritage" (42 U.S.C. 4331, Section 101(b)(4). Federal agencies must take into account project effects on these resources in accordance with the regulations at 40 CFR 1500-1508.

**Section 106 of National Historic Preservation Act (NHPA)**

Federal actions must comply with Section 106 of the NHPA which requires agencies to take in account the effects of their undertakings on historic properties and to provide the Advisory Council on Historic Preservation opportunity to comment:

> The head of any Federal agency having direct or indirect jurisdiction over a proposed Federal or federally assisted undertaking in any State and the head of any Federal department or independent agency having authority to license any undertaking shall, prior to the approval of the expenditure of any Federal funds on the undertaking or prior to the issuance of any license, as the case may be, take into account the effect of the undertaking on any district, site, building, structure, or object that is included in or eligible for inclusion in the National Register. The head of any such Federal agency shall afford the

> Advisory Council on Historic Preservation established under Title II of this Act a reasonable opportunity to comment with regard to such undertaking. (16 U.S.C. 470f)

Historic properties are resources listed on or eligible to NRHP.

**American Indian Religious Freedom Act (AIRFA)**

The goal of AIRFA is

> to protect and preserve for American Indians their inherent right of freedom to believe, express, and exercise the traditional religions of the American Indian, Eskimo, Aleut, and Native Hawaiians, including but not limited to access to sites, use and possession of sacred objects, and the freedom to worship through ceremonials and traditional rites. (42 U.S.C. 1996)

**Structure of the Thesis**

The original document on which this thesis is based was created to serve as the Cultural Resource Element (CRE) or appendix to the Fire Management Plan for RNSP. The CRE was created under the terms of a cooperative agreement between the National Park Service (NPS) and Sonoma State University (SSU). The CRE required researching and compiling together multiple sources of information and documentation into a single confidential document for use by the NPS. This document required not only the regulatory framework, but also needed to include the cultural context both prehistoric and historic for the area in and around RNSP. Further documentation was required to include the cultural resource types used by NPS and the cultural resources currently found at the park. Additional research and documentation which was also needed related to fire and its effects on cultural resources, fire management practices, fire management at RNSP, and the compliance process during prescribed fires and wildfire events. The final portion of the CRE required the analyses and interpretation of this material in the form of tables related to fire effects on specific elements of cultural resources within three separate fuel types. Finally, these tables (matrices) are a quick reference guide for use during wildfire events to aid the park's resource advisors in protecting the cultural resources at risk.

The following chapter moves from federal laws and regulations into the cultural context of RNSP lands. The chapter describes the people who utilized the lands prehistorically, historically, and contemporaneously. The chapter is important to understand what the types of cultural materials are that can be found within RNSP boundaries.

# CHAPTER 2. CULTURAL RESOURCES CONTEXT

The following Native American ethnography sections are based on information from portions of RNSP Ethnographic Overview and Consultation Review (Robbins et al. 2005) and have been re-written for the purpose of this thesis. The cultural context begins with ethnographic overviews of the Native American groups whose homelands are located within and around the RNSP boundaries. This chapter also contains a focused summary of timber harvesting in the Humboldt and Del Norte counties, as well as an overview of sheep ranching in the Bald Hills by the Lyon family whose property has been determined eligible for listing on NRHP.

## NATIVE AMERICAN

### Yurok

The Yurok people are also known historically as the Pohlik-la, Ner-er-er, Petch-ik-lah and Klamath River Indians. The Yurok name originates from a Karuk term for "downriver" and was introduced in the 1870s as a linguistic label (Pilling 1978 as cited by Robbins et al. 2005:10). The Yurok language is an Algonquin language related to Wiyot (a neighboring tribe to the south). The ancestral territory of the Yurok is considered to encompass lands along the coast from the mouth of Damnation Creek on the north, to Little River on the south, inland along the Klamath River to Slate Creek and an area in the Bald Hills (Gates et al. 2002; Pilling 1978; as cited by Robbins et al. 2005:10).

The Yurok most likely arrived in the Northwest Coast of California around 1100 A.D. arriving from the Columbia River Plateau, via the Deschutes River Valley and the Klamath River (Whistler 1979; as cited by Robbins et al. 2005:10), bringing with them a riverine and coastal adapted fishing technology, and woodworking technology (Bickel and Salzman 1979; Moratto 1984; as cited by Robbins et al. 2005:10). According to Robbins et al (2005:10), "Waterman (1920), noted two dialectical divisions according to the habitats in which the Yurok lived: 'river' people, and 'coast' people." The majority of Yurok lived inland along the rivers, the coastal villages were small and housed less than half of the population of the inland Yurok (Waterman 1920; as cited by Robbins et al. 2005:10).

Yurok people were divided into villages and socially into families; the villages were made up of conglomerates of families or individuals; traditionally there was no governing body for the Yurok as whole (Pilling 1978; as cited by Robbins et al. 2005:10). Yurok villages were clustered by common descent from one or another important "house", most likely for protection (Pilling 1978; Waterman 1920; as cited by Robbins et al. 2005:10). Small rectangular houses made of cedar posts, redwood poles and split cedar planks made-up Yurok villages. These houses were semi-subterranean structures with an outer wall of upright planks and clay, flat stones or wood plank floors, with a rounded entrance hole at one end (Figure 2). In the interior of the structure was a square fire pit used for cooking and warmth. Women and children primarily occupied these residences while the men and boys beyond puberty, occupied the sweathouses. These men's quarters were similar in construction however the roof had only a single pitch as compared to the women and children's houses which had a three-pitched roof. A house count for the Yurok in 1852 showed 23 villages and 208 houses (Pilling 1978; as cited by Robbins et al. 2005:10-11).

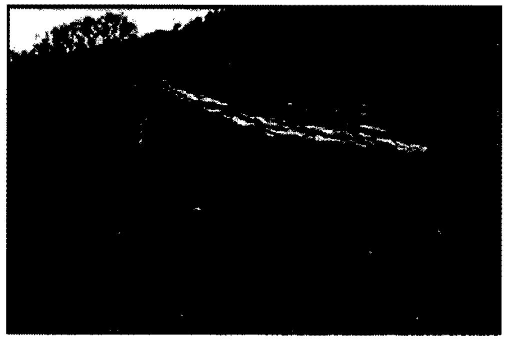

**Figure 2. Yurok house. Photo courtesy of Redwood National Park.**

The Yurok were sedentary hunters and gatherers and relied primarily on the rivers, forest, and ocean for food. The Yurok were one of the most southerly groups living on the Northwest Coast, deriving a large part of their livelihood from fishing, gathering an abundant variety of plant materials for food and basketry, and hunting for elk, deer and other game. The Klamath River was the main provider of salmon for the Yurok and other groups in the area. In pre-contact times, the salmon were harvested by utilizing fish dams, spears, or nets. The harvesting of salmon by the Yurok was carefully managed through spiritual traditions (Heffner 1984; Waterman 1920; as cited by Robbins et al. 2005:11). Steelhead trout and eels were also an important food resource from the rivers. The Yurok utilized a wide variety of marine resources as well, including shellfish, surf fish, and seaweed (Kroeber and Barrett 1960; as cited by Robbins et al. 2005:11). The forest provided acorns used to make bread and mush (Thompson 1916; as cited by Robbins et al. 2005:11). Intricate baskets were woven from a variety of plants, roots and grasses and colored with dyes made from berries, soil, bark and ferns (Pilling 1978; Theodoratus et al. 1979; as cited by Robbins et al. 2005:11). Heavy dugout canoes constructed out of redwood could carry cargos of several thousand pounds and were capable of ocean travel (Waterman 1920; as cited by Robbins et al. 2005:11). Even today, a few Yurok tribal members construct canoes when redwood logs are available (Interviews, 2003 as cited by Robbins et al. 2005:11).

Religious practices were based on the belief that long ago the earth was inhabited by a race of pre-naturals in human form. These being were called the wo'gey, and the Yurok inherited the world from them. Traditional use of medicines and other rituals was supported by the belief that the wo'gey had invented these things to help human beings (Keeling 1992; as cited by Robbins et al. 2005:11). In the Yurok's world-view, the Klamath River is seen to bisect a world surrounded by and floating on the ocean. The center of the world for the Yurok is located a few miles below the confluence of the Klamath and Trinity Rivers (Waterman 1920; as cited by Robbins et al. 2005:11). Traditional ceremonies include the Deerskin Dance, Doctor Dance, Jump Dance, Brush Dance, Kick Dance, Flower Dance, First Salmon Rite as well as others (Pilling, 1978; as cited by Robbins et al. 2005:11). The "World Renewal" is considered the most elaborate ceremony and involves recitations, displays of large finely-chipped obsidian blades, and a series of complex dances with an array of costuming. The elaborate costumes used in the ceremony include dentalium bead decorations, mink-fur ribbons, and headdresses decorated in woodpecker-scalps and other bird-feathers (Pilling, 1978; as cited by Robbins et al. 2005:11). Other ceremonies were performed for a variety of reasons, such as healing, success at deer hunting, ensuring abundant salmon runs, and acorn harvest (Robbins et al. 2005:11).

Baskets and woven caps were an important everyday item to the Yurok and were featured prominently in traditional ceremonies. Ceremonial caps were worn during some dances, medicine baskets were used in the Brush Dance for the healing of an infant or a child, and the World Renewal ceremony features basketry (Hamilton et al. 1998; as cited by Robbins et al. 2005:12).

The California Gold Rush brought an onslaught of non-Indians to the Yurok lands. Land claims were established by settlers in California, and land where the Yurok historically had collected spruce roots for basket weavers, fish and shellfish, were no longer accessible without trespassing on an Euro-American's land claim. The United States government granted the Yurok the Klamath Reserve, the original Yurok Reservation, which encompassed one mile on either side of the Klamath River for a distance of 20 miles from the mouth at the Pacific Ocean. The reservation was later extended to the confluence of the Trinity and Klamath Rivers, which connected the old Klamath Reserve with the Hoopa Reservation in 1891. The Hoopa Yurok Settlement Act of 1988 (25 U.S.C. 1300) declared this 40-mile stretch of the lower Klamath River, one mile on either side, under the management of the Yurok Tribe as the Yurok Reservation. Today, the Yurok Tribe is California's largest federally recognized Native American Tribe with nearly 5,000 enrolled members (Robbins et al. 2005:12).

**Tolowa**

The name Tolowa was most likely derived from a village near Lake Earl which was called Tolokwe (Kroeber 1925; as cited by Robbins et al. 2005:12). The Tolowa people consider their ancestral territory to extend north from Wilson Creek to the Smith River past the Oregon border, and inland along the Smith River which includes the Little Bald Hills encompassing an area roughly bounded on the east by the Del Norte County line. The Tolowa occupied an area of approximately 640 square miles (Gould, 1978; as cited by Robbins et al. 2005:12).

The Tolowa are one of the few Athabaskan-speaking groups whose territory has a substantial section of seacoast (Gould, 1978; as cited by Robbins et al. 2005 :12). It is generally assumed that the Athabaskan-speaking groups (including the Tolowa) migrated from Canada or Alaska and it is speculated to have occurred as late as A.D. 1300 (Moratto 1984; as cited by Robbins et al. 2005:12). Kroeber (1925 as cited by Robbins et al. 2005:12) estimated the pre-contact Tolowa population at 1,000; however, estimated population ranges included a low of 450 individuals to a high of 2,400 individuals (Gould 1978; as cited by Robbins et al. 2005:12).

The Tolowa people resided in approximately six or seven large permanent villages along the coastal plain between the Smith River and what is now Crescent City (Gould 1978; Collins 1998; as cited by Robbins et al. 2005:12). Gould (1978 as cited by Robbins et al. 2005:12) states that even at the height of the gathering season, the Tolowa never completely abandoned their villages. The Tolowa built houses from redwood planks, which differed slightly in style from the Yurok and the Hupa, the main difference being the double-pitched roof. The Tolowa dwellings were square semi-subterranean structures with an outer wall of upright redwood planks extending about 15 feet on each side, with clay, flat stones or wooden plank floors, and a rounded entrance hole at one end. There was also the square fire interior pit for cooking. The family homes, in which the women and children lived, were simple two-pitched plan roofs instead of the three-pitched roofs favored by the Yurok and Hupa. The men and boys (past puberty) lived in the subterranean, square and single-pitched sweathouses similar to the Yurok (Gould, 1978; as cited by Robbins et al. 2005:12-13).

The Tolowa villages lacked the social stratification typical of societies found further up on the northwest coast. Villages lacked formal chiefs or councils, but within each village resided headmen whose prestige was based on the possession and display of wealth (Gould 1978; Slagle 1985; Collins 1998; as cited by Robbins et al. 2005:13).

Harvesting of the seasonal natural resources began in early summer (Drucker 1937; as cited by Robbins et al. 2005:13). Food preservation was a well-developed skill for the Tolowa and much of the annual harvest was carefully dried and set aside for winter needs (Robbins et al. 2005:13). Seasonal foods collected by the Tolowa included seal, venison, salmon flesh, roe, shellfish and lamprey eel (Baumhoff 1963; Gould 1978; as cited by Robbins et al. 2005:13). The Tolowa's primary dietary preferences included large sea mammals, marine shellfish, salmon, acorns, waterfowl and surf-fish, and secondary dietary preferences included land mammals, berries, plants and ocean fish (Gould 1978; as cited by Robbins et al. 2005:13). Much like the Yurok, Tolowa people used large seagoing redwood canoes for sea lion hunting and deepwater fishing (Gould 1978; as cited by Robbins et al. 2005:13). The Tolowa utilized other natural resources from the abundant northwest coastal area for many cultural needs besides food, including baskets, tools, regalia and others (Robbins et al. 2005:13).

The Tolowa spiritual beliefs include beings in the past, a hominid pre-Tolowa people called the Waugies. These beings set rules for the living and then left and turned into plants, animals, or geographic sites. The guidelines set by these immortals must be followed to avoid catastrophe in life (Heffner 1984; Slagle 1985; as cited by Robbins et al. 2005:13). The Tolowa religious beliefs center around three primary foci: 1) the world of supernatural beings and the world of non-immortals with supernatural powers, 2) the world of animals with which humans share a material relationship of eater to prey, and 3) the metaphysical relationship of spirit to spirit (Slagle 1985; as cited by Robbins et al. 2005:13). The Tolowa practiced traditional ceremonies which included the Ten Night Dances or Nay Dosh (Feather Dance)/ World Renewal ceremony (similar to other local tribal groups); the Five-Night ceremony; the Hunting ceremony; Boat Consecration ceremonies as well as others (Slagle 1985; as cited by Robbins et al. 2005:13). Following contact, two major religious movements deeply impacted the Tolowa, the Ghost Dance of 1872, and the Indian Shakers, which was introduced around 1929-1930. The Indian Shakers movement peaked between the 1930's and 1940's (Robbins et al. 2005:13). In 1923, interest in the Tolowa's traditional ceremonies faded with the ban on traditional ceremony by the federal government as potlatches (a term from the northern northwest coast). Interest also faded due to problems involving alcohol consumption and disturbances at ceremonies. However, Tolowa traditional ceremonies are now being revitalized (Robbins et al. 2005:13).

In the mid-1800's, contact with non-native American settlers and miners drastically reduced populations due to the outbreak of measles and cholera, and by conflicts with the "whites" (Robbins et al. 2005:13). Numerous conflicts between the Tolowa and the new settlers/miners occurred. During 1851–1852, Del Norte settlers attacked and burned the northernmost Tolowa village of Howonquet in 1853, killing about 70 people (Robbins et al. 2005:13). In late fall of that same year, the village of Yontocket on Lake Earl, north of Crescent City was attacked by the settlers during a winter ceremony, and a large number of participants were killed and the village burned to the ground. Surving Tolowa decendants now live mainly in the Crescent City area at Smith River and Elk Valley Rancherias (Robbins et al. 2005:13).

**Hupa**

The Hupa migrated into northwest California around approximately 1300 A.D., settling along the lower courses of the Trinity River (Baumhoff 1958 as cited by Robbins et al. 2005:14). The traditional territory of the Hupa people is located on a 6-mile square in the Hoopa Valley in northwestern California and extends along the Trinity River east of the Bald Hills, and into the Trinity Alps and mountains to the east, and north to within six miles of the confluence of the Trinity and the Klamath Rivers. The primary overlap with RNSP land is in the Bald Hills, where the Hupa gathered and hunted. There were approximately one thousand Hupa living at the confluence of the Trinity and Klamath Rivers when the first Euro-Americans visited the area in 1850 (Wallace 1978; as cited by Robbins et al. 2005:14).

The Hupa people are members of the Athabascan language family, which is related to the Chilula and Tolowa tribes as well as others. Of the three groups of Athabaskan languages spoken in the northern third of Mendocino and the southern half of Humboldt counties in northwestern California (Hupa-Chilula, Mattole-Bear River, and Eel River), only Hupa is still spoken (California Athabaskan Homepage as cited by Robbins et al. 2005:14). In 1990, there were only 93 Hupa language speakers out of a population of 1,100 (1990 U.S. Census as cited by Robbins et al. 2005:14).

Permanent villages were established by the Hupa. Housing consisted of substantial rectangular structures built of cedar planks with overlapping boards covering a three-pitch roof. The houses were used as a gathering place for meals, a storage facility for food, firewood and family possessions as well as a sleeping facility for the women and young children. Like the Yurok, Hupa men and elder male children slept in the village sweathouses. The Hupa house was similar in construction to that of the Yurok house, although it was typically smaller and typically made of cedar, as opposed to redwood (Robbins et al. 2005:14).

The Hupa and their immediate neighboring tribes were unique among California Indians in the extraordinary preoccupation with wealth and social position (Wallace 1978; as cited by Robbins et al. 2005:14). In Hupa society, conventional organizations such as political authority and leadership was minimal, however for the individual, there were precise rules of conduct. The Hupa family formed the fundamental unit and typically numbered six to seven family members and lived in close proximity (Wallace 1978; as cited by Robbins et al. 2005:14).

A rich variety of plants and animals available to the Hupa were utilized for food and material items. Deer and elk were taken from the forest and the prairies. However, the main bulk of their diet was from salmon and acorns (Wallace 1978; as cited by Robbins et al. 2005:14). Acorns were harvested in the fall, particularly from the tan oak. Hupa people gathered salmon in the spring from the Trinity River by dip nets from behind weirs, gill nets in still pools, or with harpoons (Wallace 1978; as cited by Robbins et al. 2005:15). Woodworking and basket weaving were important in Hupa society. The men utilized cedar to construct house planks, chests for the storage of ceremonial regalia, platters, bowls, stools, and sweathouse headrests (Wallace 1978; as cited by Robbins et al. 2005:15). Hupa men manufactured spoons, wedges, and flaking tools from elk horn, and manufactured arrow points from chert and obsidian (Wallace 1978; as cited by Robbins et al. 2005:15). Women used a "twining" technique to weave baskets for household utensils, storage containers, cradles, caps. Hupa people did not have direct access to coastal resources, but traded with the Yurok for dried seaweed, surf fish, and hollowed out redwood canoes (Wallace 1978; as cited by Robbins et al. 2005:15), though there is a contemporary history of canoe making among the Hupa people (Interviews, 2003 as cited by Robbins et al. 2005:15).

Spirituality was and is still a fundamental part of Hupa life. Mervin George Sr., a community curator of the Hupa, explained the sacredness of most anything from mountains to crops, and described the importance of the religious ceremonies he leads. "When they leave this world, all the K'ixanay (ancestors) go to a place where they dance forever," he said. "So when we pray, we ask them to come back and dance with us" (Banks 2004; as cited by Robbins et al. 2005:15). The World Renewal Ceremony is also important to the Hupa people, and is similar in general to the ceremonies of the Yurok (Robbins et al. 2005:15).

The Hupa remained predominately secluded in their remote valley until contact with the Euro-Americans during the Gold Rush in 1850. A few miners settled in the valley and eventually homesteaders slowly moved in. In 1858, federal troops were stationed at Fort Gaston in the Hoopa Valley where they remained until 1892. In 1876, the Hoopa Valley Indian Reservation was set aside by President Grant. In 1891, President Harrison extended the boundary of the reservation to include an adjoining one mile on either side of Klamath, 45 miles from the confluence of the Trinity and Klamath Rivers to the ocean. Commonly known as the "Addition," most residents along this 45 mile tract were actually Yurok. In 1988, the "Addition" became the Yurok Reservation with the passage of the Hoopa Yurok Settlement Act (Robbins et al. 2005:15).

**Chilula**

The Chilula are believed to be the original inhabitants of the Redwood Creek Valley (Lake 1979; as cited by Robbins et al. 2005:15). Their territory encompassed most of the lower portion of Redwood Creek, up to a few miles above Minor Creek and the Bald Hills (Wallace 1978; as cited by Robbins et al. 2005:15). On the eastern boundary, the Bald Hills served as a shared place for ceremonies, hunting and gathering, and weddings with the neighboring Hupa (Wallace 1978; as cited by Robbins et al. 2005:15). The Chilula language belongs to the larger Athabascan language group (Robbins et al. 2005:15).

The Chilula were a hunter-gatherer society and shared many cultural traits with the southern Whilkut (Goddard 1914; as cited by Robbins et al. 2005:15). The social and political practices of the Chilula were similiar to those of the Hupa (Wallace 1978; as cited by Robbins et al. 2005:15), and intermarriage between the two neighboring groups was common. The Chilula had a more migratory lifestyle, traveling to gather seasonal resources and harvests (Robbins et al. 2005:16). These people were dependent upon vegetable food, but also were skilled hunters of deer and elk in the forest. Temporary camps were set-up annually at certain locations during the summer months, mainly in the grassy open areas of the Bald Hills where seeds, bulbs and game were plentiful. During the fall, they would cross Redwood Creek to harvest acorns (Goddard 1914; as cited by Robbins et al. 2005:16).

According to Robbins et al. (2005:16), the Chilula religion appears to have been less complex than that of the Hupa. There is little evidence as to whether the Chilula followed a similar ceremonial pattern to that of their neighbors. Ritual observances for pubescent females, and magico-religious practices concerned with death and burial, however are known to conform to those of their neighboring tribes (Wallace 1978; as cited by Robbins et al. 2005:16).

The population before the arrival of Euro-Americans numbered between 500 and 600. Within five years of California statehood, the Chilula population was decimated (Wallace 1978; as cited by Robbins et al. 2005:16). With the Gold Rush in the 1850's, miners seeking their fortune on the Klamath and Salmon rivers used the Redwood Creek valley as the main travel route. Some of the Chilula raided the packtrains, Euro-Americans retaliated by shooting the Indians on sight. The remaining Chilula people were asimilated by the Hupa most likely due to their family ties and affiliations. Sixty-five years after the Chilula first came in contact with the Euro-Americans, they ceased to exist as a separate people (Goddard 1914; as cited by Robbins et al. 2005:16).

## Focused History of Timber Harvesting and Logging

The following section on timber harvesting and logging has been re-written as a summary based on information from Edwin Bearss' (1969) online book Redwood National Park: Basic History Data. The online resource has no page numbers but the information contained below can be found in chapter 10.

### The Lumber Industry in Humboldt County—1850–1860

### The First Sawmills

In the 1850's, the redwood zone in Humboldt County extended in an irregular belt along the coast 108 miles in length, varying in width from two to 20 miles, and encompassed approximately 500,000 acres. The territory of the redwood zone included level river bottoms, plateaus, rolling land, and steep hillsides. In 1902, foresters calculated that an average of 50,000 merchantable feet of lumber could be harvested from an acre (Bearss 1969:np).

Lumbering commenced in the redwood zone in 1850 but five years were to pass before any attention was paid to the redwoods. The pioneer lumbermen were from Maine and the Maritime Provinces of Canada, who were accustomed to using pine, spruce, and fir for construction of their homes. These men realized the potential of the redwood species for lumber used in the building trades, but because of the inability of the mills to handle the huge redwood logs, along with their ignorance of its adaptability for lumber, no redwood was shipped from Humboldt Bay until 1855 (Bearss 1969:np).

According to Bearss (1969:np), on February 24, 1852, the first really successful mill in the county was established by James T. Ryan and James Duff. Within a short time, Ryan & Duff were sawing several thousand feet of spruce, fir, and pine a day. However, three ships, the John Clifford, the Cornwallis, and the Home all sank with loads of lumber during the year of 1852. Despite these blows and the destruction of their mill by fire, Ryan & Duff continued in business (Bearss 1969:np).

One man who went to work for Ryan & Duff was named William Carson, a Canadian who brought the first ox team to Humboldt County (Bearss 1969:np). In 1854, Carson left Ryan & Duff and purchased the Hula Mill. Within a year he shipped 20,000 board feet of redwood lumber to San Francisco aboard the ship Tigress. The redwood was almost an instantaneous success due to rot-resistance and soon commanded premium prices. Carson's Hula Mill was small, capable of producing only 5,000 feet of lumber a day (Bearss 1969:np).

**The Humboldt Lumber & Manufacturing Co.**

According to Bearss (1969:np) by 1854, there were nine mills operating on Humboldt Bay. It was soon apparent to the management that the local market and the San Francisco market were unable to consume the entire output of the growing Humboldt Bay lumber industry. In order to foster trade with Atlantic Coast ports and to secure other market opportunities, the mill operators determined that they would pool their resources. After a series of meetings, a number of mill owners united to form the Humboldt Lumber & Manufacturing Co., with a capitalization of $380,000. James T. Ryan was elected president and Martin White vice president of the new coalition (Bearss 1969:np).

In 1854 the company exported 20,567,000 feet of lumber. Unfortunately, the mill owners/operators were better production experts than they were businessmen. When a number of customers failed to meet their obligations, the company fell into serious financial crisis. By December 1854 many mills were compelled to suspend operations. The Humbolt Times ran ads of sheriff's sales of the mills, and by April 1855 the mills of the association were turned over to their creditors. A new policy was put into place which permitted only cash transactions, and limited operations were resumed. Recovery for the mills from the financial crisis was slow (Bearss 1969:np).

**Status of the Industry in 1860.**

By 1860 Humboldt County was the second ranking California county in production of lumber, producing 30,000,000 feet per year. In Humboldt County, the majority of lumber produced was redwood, spruce, fir, and small quantities of cedar. Most of the lumber from Humboldt County was shipped to the San Francisco market. Most of the mills were on the shore of Humboldt Bay, which was bounded by flats about five to six miles across (Bearss 1969:np).

## The Lumber Industry in Del Norte County—1853–1881

### The First Sawmills

The first sawmill in what is now known as Del Norte County was established in 1853 (Bearss 1969:np). The machinery for the mill was landed from Pomona in May of that year. F. E. Watson built and operated the first mill for R.

F. Knox & Co. of San Francisco, CA. This mill was located in the gulch near the intersection of today's Third and C Streets in Crescent City. The majority of the logs for the mill were hauled over Howland Hill from Mill Creek. To transport the logs to the mill, the loggers utilized "two large wheels about twelve feet in diameter, with an axle between and a long tongue, on which the logs were loaded, and partly dragged and wheeled by oxen" (Bearss 1969:np).

Following the completion of the Oregon & California Railroad to Redding, CA and Roseburg, OR in 1865, there was a significant decline in the freighting and packing trade in the Crescent City area. A local businessman, J. Wenger, Sr., held a public meeting in 1869 concerning the steps which needed to be taken to shore up the county's sagging economy. At the meeting, the community determined to organize a corporation for the construction of a sawmill which would utilize "the immense stand of redwood and spruce so providently accessible"(Bearss 1969:np). The company was organized and designated the Crescent City Mill & Transportation Company. Construction began immediately, with John H. Chaplin and J. Wenger, Sr., in charge. The newly constructed mill, called the Lake Earl Mill, was located two miles north of Crescent City, on the shores of Lake Earl. Until 1880 the mill was plagued by shallow water in the lake. A dam was then constructed across the outlet of the lake, about one-fourth mile below the mill. Behind the dam there was always sufficient water to float the biggest logs. The lake would hold 3,500,000 feet of timber, sufficient to keep the mill running for an entire year (Bearss 1969:np).

**The Lyon Family Sheep Ranch (Bald Hills Region)**

The following section is a summary based upon information from *National Park Service Cultural Landscapes Inventory Lyons Ranches Historic District Redwood National Park* (NPS 2004:30–42). The Lyon Ranches Historic District is listed on the NRHP.

**Lyons Family and Sheep Ranching in the Bald Hills – Initial Settlement**

In 1850, Jonathan Lyons, came west from Iowa when he was eighteen or nineteen years old. He settled in Oregon, but by the time of the 1860 census, he was in California at the fork of the Salmon River in Siskiyou County. The area was being utilized for gold mining, although Jonathan appears to have been an entrepreneur rather than a miner (NPS 2004:30). He grew vegetables and butchered cattle for a living supplying the miners with meat and vegetables. He settled in the Hoopa Valley in approximately 1861 and began raising stock in partnership with a man named Shearer. Jonathan married a Hupa woman named Amelia. Their first son, Anderson, was born there in December 1863. When the Hoopa Valley Reservation was created in 1864 following the end of the Indian Wars, Jonathan and family left the Hoopa Valley. They were among the first of the immigrant settlers to go back into the Bald Hills following the removal of the Chilula from their homelands at the end of this conflict (NPS 2004:30). At the time of the 1865 tax assessment, he and his growing family were living at Marrup flat on the lower Klamath River, where his son Sherman was born in December 1865. He was listed as having a house and garden and was assessed for forty-four breeding mares, a jack, a stud, and two horse and mule colts (NPS 2004:30). His son Harvey was born on Redwood Creek in the

Redwood Valley in December 1868. By the 1868 tax assessment, Jonathan and family had settled at Sluffman's Point in the District on what became known as the Home Place (NPS 2004:30). Within twenty years, Jonathan acquired over 3,600 acres. Almost all of this land was in Coyote Creek, the centerpiece of the Lyons Home Place, the first lands acquired by the family and the last to leave family ownership in 1986 (NPS 2004:30).

**Acquiring Land and Establishment of Sheep Ranching Operations.**

During the next twenty years following his initial settlement in the Bald Hills in 1868, Jonathan Lyons established his position in the local community and expanded his ranching operations. He built a home and barn at the Home Place, and it was during this time that the Lyons's remaining four children were born at the Home Place: Antonio in January 1870, William in March 1872, Josephine in February 1876, and Julius in 1878 (Stanton and Van Kirk 1992: Appendix A as cited by NPS 2004:31). The Lyon home was a focus of the developing community of ranchers. A school was built on his land and the teacher lived at the Lyon family house.

By 1885, Jonathan's ranch was running approximately 3,000 sheep. Sheep ranching became the primary part of the commercial operation, but were cattle and horses were raised for the needs of the ranch and family (Stanton and Van Kirk 1992 as cited by NPS 2004:32). The prairie grasslands of the Bald Hills were utilized by the sheep to forage, but needed to be herded from one pasture to another (NPS 2004:32).

Between 1888 and 1900, as his sons reached adulthood, Jonathan began to start family business partnerships (NPS 2004:34). Jonathan and his sons continued to acquire land in the District and to expand their sheep ranching operations. Homes were built for each of the sons as they married and started their own families (NPS 2004:34).

It was during the 1890s that the barns and sheep sheds (which are the key contributing features of the District) became a part of the Lyons's operations. The winter of 1890 was a setback for the family's ranching operations (NPS 2004:34). Up until that time, during the winter, sheep grazed out in the open in one of the prairies located at a lower elevation. However, the winter of 1890 was one of the most severe recorded in northwestern California. The weather caused thousands of cattle and sheep to perish in the snow for lack of shelter and feed. Jonathan Lyons lost virtually all of his herd (NPS 2004:34). It was after this time that Lyons began to build sheep sheds on the prairie pastures. These constructed sheds with hay-filled mows provided the shelter and feed for wintering bands of sheep (NPS 2004:34).

The Lyons family sheep ranching was continued until some-time in the 1960's. Austin Eugene (Gene) Lyons, Antonio's son, was the third generation of the family to ranch the District lands. The lands remained in his ownership until his death in 1972 (NPS 2004:40).

The following landscape description is based upon the information contained in *National Park Service Cultural Landscapes Inventory Lyons Ranches Historic District Redwood National Park* (NPS 2004:6).

**Landscape Description**

The Lyons Ranches Historic District is located within the Bald Hills of Redwood National Park and is set within the prairies and oak woods of the Redwood Creek watershed. The 5,660-acre district is comprised of a series of eight prairies and the features (such as the family structures and barns) within these prairies that remain from the Lyons family sheep ranching era (NPS 2004:6). The eight prairies of the district extend for approximately six miles. The prairies are located along the ridge of the hills and are naturally occurring features that have been modified over time by the cultural practices by Native Americans and through ranching. The historic district is "significant under National Register Criterion A for its association with the history and development of the Bald Hills as a sheep ranching community and for its association with the establishment and development of social and economic relationships between Native American people and the immigrant Euro-American society in the Bald Hills" (NPS 2004:6). The district is also significant under Criterion C at the local level as an example of a large-scale sheep ranch from the late nineteenth to mid-twentieth centuries in Humboldt County (NPS 2004:6). The district is virtually absent of any intrusions following the period of significance. "Contributing landscape characteristics of the district include natural systems and features (including the eight prairies – Elk Camp, Dolason Hill, Counts Hill, Childs Hill, Schoolhouse Prairie, Lower Coyote Creek, Long, and Coyote Creek prairies), historic archeological sites, buildings and structures, small scale features, vegetation, circulation, topography, spatial organization, and cluster arrangement" (NPS 2004:6). Key contributing features include the Bald Hills Road; the Elk Camp Sheep Shed, Lane House and Garage at the Elk Camp Prairie; Dolason Sheep Shed in the Dolason Hill Prairie; Home Place Barn, Bunkhouse, Outhouse, and Cemetery at the Home Place in the Schoolhouse Prairie; the Dooleyville Line Cabin in the Lower Coyote Creek Prairie; Long Ridge Sheep Shed and Herders' Trailer in the Long Prairie; and the Coyote Creek Sheep Shed, Line Cabin, Outhouse in the Coyote Creek Prairie (NPS 2004).

Finally, remnant orchards and individual orchard trees are located in numberous of areas within the District (NPS 2004:6).

The following chapter is an important resource for the definition of cultural resource types used by government agencies. These definitions are used in order to categorize cultural resources for better management.

# CHAPTER 3. CULTURAL RESOURCE TYPES

The chapter begins by defining the cultural resource property types recognized by the NPS. Next, the process of consultation between NPS and Native American tribes concerning their heritage resources is described. Finally, a description is offered of the cultural resources of REDW including properties listed on the NRHP as of 2009.

## RESOURCE TYPES AND THE NPS

This section describes generic resource types recognized by NPS. It is excerpted largely verbatim from Chapter 1 of NPS-28 Cultural Resource Management Guideline (NPS 1998).

> "The National Historic Preservation Act recognizes five property types: districts, sites, buildings, structures, and objects. As called for in the Act, these categories are used in the National Register of Historic Places, the preeminent reference for properties worthy of preservation in the United States. To focus attention on management requirements within these property types, the NPS *Management Guideline* categorizes cultural resources as archeological resources, cultural landscapes, structures, museum objects, and ethnographic resources."

> "Resource categories are useful because they help organize cultural resources into a manageable number of groups based on common attributes. On the other hand, categorization may obscure the interdisciplinary nature of many cultural resources. An early farmhouse, for example, may be filled with 19th-century furniture, form the centerpiece of a vernacular landscape, and occupy the site of a prehistoric burial mound. In addition to this type of overlap, cultural resources might also embrace more than one category or classification system. A stone ax can be both an archeological resource and a museum object, just as a fence may be viewed as a discrete structure, the extension of a building, and part of a landscape. Taken a step further, historic districts can be formed by various combinations of

cultural landscapes, structures, and ethnographic and archeological resources."

**Archeological Resources**

"*Archeological resources* are the remains of past human activity and records documenting the scientific analysis of these remains. Archeological resources include stratified layers of household debris and the weathered pages of a field notebook, laboratory records of pollen analysis and museum cases of polychrome pottery. Archeological features are typically buried but may extend above ground; they are commonly associated with prehistoric peoples but may be products of more contemporary society. What matters most about an archeological resource is its potential to describe and explain human behavior. Archeological resources have shed light on family organization and dietary patterns, they have helped us understand the spread of ideas over time and the development of settlements from place to place."

**Cultural Landscapes**

"*Cultural landscapes* are settings we have created in the natural world. They reveal fundamental ties between people and the land–ties based on our need to grow food, give form to our settlements, meet requirements for recreation, and find suitable places to bury our dead. Landscapes are intertwined patterns of things both natural and constructed: plants and fences, watercourses and buildings. They range from formal gardens to cattle ranches, from cemeteries and pilgrimage routes to village squares. They are special places: expressions of human manipulation and adaptation of the land."

**Structures**

"*Structures* are material assemblies that extend the limits of human capability. Without them we are restricted to temperate climates, the distances we can walk, and the loads we can carry. With them we can live where we choose, cross the continent in hours, and hurl a spacecraft at the moon. Structures are buildings that keep us warm in winter's worst blizzard and bridges that keep us safe over raging rivers; they are locomotives that carry us over vast prairies and monuments to extend our memories. They are temple mounds and fishing vessels, auto factories and bronze statues–elaborations of our productive ability and artistic sensitivity."

**Museum Objects**

*"Museum objects* are manifestations and records of behavior and ideas that span the breadth of human experience and depth of natural history. They are evidence of technical development and scientific observation, of personal expression and curiosity about the past, of common enterprise and daily habits. Museum objects range from a butterfly collection to the woven fragments of a prehistoric sandal. They include the walking cane of an American president, a blacksmith's tools, and the field notes of a marine biologist. They encompass fossilized dinosaur bones and business journals, household furnishings and love letters bound with a faded ribbon. They are invaluable– samples and fragments of the world through time and the multitude of life therein."

**Ethnographic Resources**

*"Ethnographic resources* are basic expressions of human culture and the basis for continuity of cultural systems. A cultural system encompasses both the tangible and the intangible. It includes traditional arts and native languages, religious beliefs and subsistence activities. Some of these traditions are supported by ethnographic resources: special places in the natural world, structures with historic associations, and natural materials. An ethnographic resource might be a riverbank used as a Pueblo ceremonial site or a schoolhouse associated with Hispanic education, sea grass needed to make baskets in an African-American tradition or a 19th-century sample of carved ivory from Alaska. Management of ethnographic resources acknowledges that culturally diverse groups have their own ways of viewing the world and a right to maintain their traditions."

## CULTURAL RESOURCE TYPES IN RNSP

Cultural resources in RNSP include archeological sites, historic structures, ethnographic resources, cultural landscapes, and museum objects (NPS 2004b:60). Within these general categories examples of the following resource types have been identified within RNSP (NPS 2004b:60):

Prehistoric resource types

- Habitation site/camp

- Lithic scatter
- Chert quarry
- Trail

Historic-era resource types

- Building
- Wooden fence
- Utility pole
- Orchard/fruit tree
- Cement cistern
- Cement water trough
- Embankment
- Gravestone
- Artifact concentration
- Stockpond
- Skid road
- RR grade
- RR track
- RR sleeper
- Logging equipment
- Bridge
- Tailings/mine waste
- Ditch
- Adit

Ethnographic/Traditional Resource Types

- Basketry and food collection site
- Goose pen (hollow tree)
- Ceremonial/spiritual site
-

**Native American History and Consultation at RNSP**

The following section describes the important background information on prehistoric, historic, and contemporary use and occupation of the land within the boundaries of RNSP. The section begins by describing the process of consultation by which Native American tribes in the study area are involved in the definition of their ancestral resources, and goes on to describe several cultural resource types known to be present in RNSP. It consists of excerpts, largely verbatim, from the *FMP Environmental Assessment* (NPS 2004b:60–64).

**Native American History and Consultation**

Human occupation or use of land under REDW jurisdiction and vicinity dates to as early as 5,000 to 7,000 years ago (Benson 1983). Evidence of prehistoric human activities include village sites, seasonal camps, and trail use sites reflected in the archeological record by artifact concentrations and associated features found in the Bald Hills prairies, along the coast, and in some instances within forested areas in the Redwood Creek basin and other perennial drainages. Historic-period activities on park lands included exploration, cattle and sheep ranching, dairies, farming, logging, mining, establishment of overland transportation routes, and World War II and cold war era military history. American Indians have lived in the area continuously for thousands of years. They live in local communities, reservations, or rancherias around the parks, and continue to practice traditional lifeways. Lands that are now part of RNSP are within aboriginal Tolowa, Yurok, and Chilula territory. Tolowa territory extended north along the coast from Wilson Creek and included most of the Smith River watershed in the interior. Yurok territory bordered the Tolowa to the south and extended from Wilson Creek to the Little River along the coast, and included the lower 45 miles of the Klamath River watershed. Chilula territory included most of the lower Redwood Creek drainage and included the Bald Hills area (Eidsness 1988).

The Klamath River Reservation was established along the lower portion of the river in 1855 through a presidential executive order. In the late 1860s and 1870s, a number of Americans took up residency on the reservation but were evicted in 1879. In 1891, President Harrison enlarged the nearby Hoopa Valley Indian Reservation to include lands along the Klamath River to one mile on either side of the river, from just upriver of Weitchpec to the Pacific Ocean, thus encompassing the original Klamath River Reservation. In 1892, Congress opened the reservation to homesteading by non-Indians and awarded allotments to Indians living along the river.

Following severe flooding along the Klamath River in the winter of 1861-62, the reservation was essentially abandoned. A new reservation site was selected north of Crescent City. Numerous Tolowa were concentrated here, along with members of tribes from the Mad and Eel Rivers south of aboriginal Yurok territory. Because of the homesteading, the majority of lands along the Klamath River within reservation boundaries are owned by non-Indians. The Hoopa-Yurok Settlement Act of 1989 divided the Hoopa Valley Indian Reservation into the Yurok and Hoopa Valley reservations. The Yurok and Hoopa Valley tribes are currently amending the Act to establish jurisdiction for lands and resources, and to provide the legal background for appropriation of funds, management of lands and resources, and development of infrastructure and economic opportunities for the Yurok Tribe..

The NPS has held regular consultations with the American Indian community since 1978, initially with five American Indian heritage advisory committees representing different geographic areas of the parks and different Indian groups. In the 1990s, consultations shifted from heritage advisory committees to tribal governments. Currently, there are five tribal governments whose members have ties to lands within the parks. These governments include three Tolowa governments (Smith River Rancheria of California, Elk Valley Rancheria of California, and the Tolowa Nation); the Yurok Tribe of the Yurok Reservation, California; Coast Indian Community of Yurok Indians of the Resighini Rancheria, California; Big Lagoon Rancheria of California; and Cher-Ae Heights Indian Community of the Trinidad Rancheria, California; and the Hoopa Valley Tribe of the Hoopa Valley Reservation, California. Only the Tolowa Nation is not a federally recognized tribe. Although most NPS consultations are with the Yurok Tribe, whose ancestral territory includes much of the national park, consultations with all tribes with ancestral ties to the park occurs regularly.

In 1996 a memorandum of understanding (now called a general agreement) was signed by the NPS, CDPR, and the Yurok Tribe, establishing and formalizing a government-to-government relationship. Since that time, the Yurok Tribe, under the provisions of the Tribal Self-

Determination Act of 1994, have assumed state historic preservation office functions for all lands within the reservation boundaries.

**Archeological Resources**

As of 2009, 148 archeological sites were documented in the RNSP of which 111 are documented on NPS lands and 37 are documented in Prairie Creek Redwoods State Park, Del Norte Coast Redwoods State Park, and Jedediah Smith Redwoods State Park. Thirty-six of these archeological sites are listed on the NRHP and one has been formally determined eligible for listing on the NRHP. These include prehistoric village sites, seasonal camps, procurement sites, and trail use sites. Historic period sites include structures and associated features related to ranching and farming, historic-period trash scatters related to settlement, logging, and mining, and various ranching landscape features such as fence lines and stock ponds.

The Bald Hills Archeological District was listed on the NRHP in 1982 and the Bald Hills Archeological District Extension (Boundary Increase) was listed on the NRHP in 1985. The District consists of 26 sites including villages, seasonal camps, trail use routes, concentrations, flake scatters, and a ceremonial place all located in the Bald Hills portion of the park.

Prairie Creek Redwoods State Park contains additional prehistoric resources including a Yurok village site, two flake scatters, and one chert quarry. Another site is a trash dump with both historic and prehistoric components. Prairie Creek Redwoods State Park also includes the Old Cabin and Store Site at the south end of Boyes Prairie and the site of a civilian conservation corps camp in Elk Prairie. Although none of these sites have been evaluated for listing on the NRHP, each is considered to be potentially eligible for listing until determined otherwise. There are many sites in Jedediah Smith Redwoods and Del Norte Coast Redwoods State Parks consisting of historic mining ditches, historic roads, prehistoric villages, and campsites, as well as cultural landscapes, resources of ethnographic significance, and other historic structures.

**Buildings and Structures**

Thirty-one buildings and structures in the RNSP are included on the NPS List of Classified Structures (LCS). Three are listed on the NRHP and twelve are incorporated in the Lyon's Ranch Cultural Landscape determined eligible by NPS and SHPO consensus (September 2004).

Listed on the NRHP are the World War II Radar Station B–71, Redwood Highway, and Prairie Creek Fish Hatchery. Several barns, cabins, outbuildins, a gravesite, and water related features contribute to the Lyons' Ranches Rural Historic Landscape District.

In Prairie Creek Redwoods State Park, the Elk Prairie Visitor Center and associated features are all historically significant as examples of Civilian Conservation Corps (CCC) construction carried on in state parks during the 1930s. The site consists of the headquarters building, a comfort station at the rear of the headquarters building, a footbridge to the northeast, and a concrete picnic stove along the south side of Prairie Creek. The headquarters is also significant as an example of the rustic, nonintrusive architectural style pioneered by the NPS between 1916 and 1942. In addition, the DeMartin Youth Hostel, although determined ineligible for the NRHP, is maintained as a historic structure by the NPS and it is currently listed on the LCS.

The Boyes House and associated buildings and structures are in the northeastern section of Elk Prairie (Boyes Prairie). The site consists of an early 20th century Bungalow Style residence, a detached garage built around the same time as the house, four modern park maintenance buildings, three one-story cottages erected around 1947 to 1948, and a small orchard that surrounds the south and west sides of the Boyes House.

**Ethnographic Resources and Traditional Activities on Park and Aboriginal Lands**

Ethnographic resources "are basic expressions of human culture and the basis for continuity of cultural systems" and encompass both the tangible (native languages, subsistence activities) and intangible (oral traditions, religious beliefs). These can include archeological sites, old ethnographic village sites, travel routes, fishing and hunting camps, locations of ceremonial significance, and areas traditionally used to gather resources. The Bald Hills and Klamath River Ethnographic Districts are both areas containing all of the various forms of ethnographic resources. Village sites, many now recorded as archeological sites are found throughout these areas. Many prominent natural features found in these areas are of special ceremonial significance to American Indians and include prayer seats or areas used for the world renewal or brush dance ceremonies. Plant resources used include but are not limited to hazel shoots and nuts, salmonberry, tanoak, black oak, elderberry, ocean spray, gooseberry, huckleberry, honey suckle plant, "wild parsley," bear grass, horse tails, maple , madrone, licorice fern, and Manzanita (Gates et al. 2000, 2002).

Principal settlements for all three groups (Tolowa, Yurok, Chilula) were typically situated along the coast and rivers or creeks. Villages were often located in clusters with the population centered around a large village with smaller villages or hamlets in the vicinity. These locations were occupied by the bulk of the population throughout the year with temporary campsites near specific resources used seasonally by small groups to exploit seasonally available resources. The range of resources utilized and subsistence technology were diverse. Shellfish collecting, fishing, sea and land mammal hunting, fowling, and gathering edible and medicinal plants, especially acorns were important subsistence activities. These resources were gathered while seasonally abundant and were then stored to provide nourishment during lean times of the year. Shelter consisted of houses and sweathouses made from split redwood or cedar planks. Basketry and wood-working were important and wealth was recognized in the form of non-subsistence goods such as very large chert and obsidian blades, white deerskins, red woodpecker scalps, and dentalium shells (Gould 1978; Pilling 1978; Wallace 1978).

Fire use consisted of intentional burning of open prairies, burning of understory around tanoak and white oak stands, and other areas. Hazel sprouts and bear grass were gathered for use in basketry, and various seeds and tubers were collected for food. Burning not only made resource collection easier, but also eliminated competition stimulating plant growth. Oak stands were burned to maintain the open stands and improve acorn harvests. Prairies were burned to maintain the open grassland and to improve browsing areas for large game animals that were taken for food (Lewis 1993; Anderson 1993; Gates et al. 2000, 2002; Underwood et al. 2003).

Among the local Yurok, Tolowa, and Hupa, many aspects of the traditional lifeways continue on both RNSP and adjacent lands. The parks contain sites that are integral to the practice of traditional American Indian spirituality, subsistence, and lifeways. Some fishing areas, gathering areas, and ceremonial sites now within RNSP have been used by the ancestral American Indian community for thousands of years. Certain dances are held, and others are being revived that entail the maintenance of dance sites with their traditional structures and the fabrication of dance regalia. Many of the arts, such as canoe making and basket weaving, also are practiced, which require certain natural resources — many of which are found within the parks. These arts are sources of economic as well as spiritual sustenance.

**Cultural Landscapes**

Currently there are six known cultural landscapes in the national park eligible for or potentially eligible or listing in the NRHP: the Bald Hills Ethnographic District, Klamath River Ethnographic District, Lyons' Ranches Historic District, Old Redwood Highway, Prairie Creek Fish Hatchery, and Radar Station B–71. These resources are also listed on the NPS Cultural Landscape Inventory.

Currently the Old Redwood Highway, Prairie Creek Fish Hatchery, and Radar Station B–71 are listed on the NRHP as structures, and the Lyons' Ranches Historic District has been determined eligible by NPS and SHPO consensus. A National Register nomination form was completed for the Lyons' Ranches Historic District (Bradley and Corbett 2001) located in the Bald Hills area of REDW. Contributing features of the Historic District include Elk Camp, Dolason Hill, Counts Hill, Childs Hill, Schoolhouse Pasture, Long, and Coyote Creek Prairies and associated structures.

In Prairie Creek Redwoods State Park, the visitor center and associated structures are part of a cultural landscape that is potentially eligible for listing on the NRHP. Some prairies may be eligible for listing as ethnographic landscapes that were maintained through traditional practices such as burning and thinning.

**National Register Properties**

Four prehistoric archeological sites, two complexes, and one archeological district (consisting of 26 archeological sites) are listed on the NRHP or determined eligible by the Keeper of the NRHP. In addition, the Lyons' Ranches Rural Historic Landscape District has determined eligible for the NRHP through NPS and SHPO consensus.

Also listed on the NRHP are the World War II Radar Station B–71, a portion of the old Redwood Highway, and the Prairie Creek Fish Hatchery.

**Undiscovered Cultural Resource Types at RNSP**

The rugged terrain and intense groundcover in RNSP makes locating archaeological resources/types extremely difficult. Resource types such as museum objects and archaeological resources are frequently obscured by dense vegetation which also impedes the progress of inventory teams in the field. Given these constraints as well as the abundance of natural resources, the length of prehistoric occupation, and the historic-era use of the area for ranching, mining, and logging it is likely, even probable, that resource types in addition to those identified above are present within RSNP.

The next chapter contains the information on the effects of fire and fire management on cultural resources. It is closely related to the types of resources found at RNSP. The cultural resources can be adversely affected by fire or fire management. The chapter describes the effects of fire on various cultural materials as well as the effects that fire management can have on these resources.

# CHAPTER 4. EFFECTS ON CULTURAL RESOURCES OF FIRE AND FIRE MANAGEMENT ACTIVITIES

The following chapter describes the effects of fire and fire management activities on cultural resources. It begins by describing the direct effects of fire on specific cultural materials and then goes on to describe the effects on cultural resources of fire management activities.

## THE EFFECTS OF FIRE

Section 106 of NHPA and its implementing regulations at 36CRF800 require that federal agencies take into account the effects of their undertakings on NRHP-eligible properties. In this context, effect can be defined as a change in the characteristics that render a property eligible for the NRHP. Siefkin (2001:np) defines three categories of effects on cultural resources from fire and fire management activities: direct, operational, and indirect effects. Direct effects are caused by the fire itself due to heat or smoke damage. Operational effects on cultural resources occur as a result of actions taken by fire personnel to implement, manage, and/or suppress wildland fires and during non-fire treatments such as mechanical thinning of fuels. Indirect effects on cultural resources from wildfire management and non-fire fuels treatments may cause runoff and erosion, tree mortality, increased rodent activity, and looting or vandalism of archaeological sites. Indirect effects can also adversely alter the context in and around the vicinity of archaeological resources such as traditional cultural properties (TCPs).

RNSP contains the types of cultural resources described in the previous chapter. Each type contains various cultural materials that can be affected in dissimilar way by fire and fire management activities. The following section describes how each of the cultural materials associated with these archaeological resources can be adversely affected by fire or fire management activities.

## Direct Effects of Fire

Cultural resources can be affected directly from burning, heat, and smoke. Direct effects are most troublesome as all archaeological resources within each Fire Management Unit (FMU) have the potential to be exposed to fire and our understanding of these effects on some cultural materials is not yet well developed.

### Fire Severity Classes

Fire severity is the magnitude of the effects that fire has on the environment including vegetation, soil, geomorphology, watersheds, wildlife habitats, and human life and property (Sugihara et al. 2006: 69). Siefkin (2001:36) divides fire severity into four classes based on increasing temperatures: non-fire, low, moderate, and high. The higher the fire severity, the greater the risk of damage is to cultural resources. Table 1 shows the differences of the fire severity classes. The following fire severity descriptions are summarized from information contained in Sugihara et al. (2006).

***Low Fire Severity.*** A low severity fire produces only slight or no modification to vegetation structure and most of the mature plants survive. A small proportion of the area burns at a higher severity level.

***Moderate Fire Severity.*** In a moderate severity fire most of the area burns in fires that are moderately stand modifying, with most individual mature plants surviving. A small proportion of the area burns at a lower and higher fire severity levels.

*High Fire Severity.* A high fire severity class is very destructive of vegetation. Fire kills most of the above-ground plants over most of the area. Many mature individual plants may survive below ground and resprout. A small portion of the burn area burns at lower fire severity classes.

**Table 1. Fire Severity Classes (adapted from Siefkin 2001:36)**

| Severity | Characteristics |
|---|---|
| *Non-fire* | Little or no occurrence of natural fire. |
| *Low* | Light surface fire; some small trees may be killed. In woodlands, fire does not substantially change the structure of the dominant vegetation. |
| *Moderate* | Most small trees killed; some sub canopy trees killed or heavily damaged. Charring occurs on the bark of live trees, and overstory trees may occasionally be killed. Larger and fire-resistant trees most often survive. Can be considered a "mixed" severity fire regime. |
| *High* | Small and sub canopy trees killed, many to most overstory trees killed. The above-ground parts of dominant vegetation are killed, drastically changing the above ground structure. |

*Fireline Intensity and duration effect.* Patterns of fireline intensity (peak temperatures), fire duration, and the amount of fuels, affect fire severity level. Van Wagtendonk (in Sugihara et al. 2006:53), gives an example of a high-intensity fire of short duration that could result in the same level of severity as a low-severity class fire at a longer duration. Similarly, the same fire behavior can result in different effects on overstory, understory, and soils (Sugihara et al. 2006:53). Although fire severity will affect cultural resources, it is the fireline intensity (both the temperature of heating and the duration of heating) that has the most direct impact on cultural materials.

***Fuel Model and Load.*** Fuels are any combustible material such a grasses, duff, shrubs, and trees. To model fire behavior, fuel types with similar characteristics are grouped into stylized "fuel models," which include different combustion variables (Sugihara et al. 2006:42). Fuel characteristics are defined as factors that affect fuels' combustion such as compactness, loading, horizontal continuity, vertical arrangement, chemical content, size and shape, and moisture content (NWCG 2009). Fuel models are used to predict a fire's intensity and rate of spread (Sugihara et al. 2006:42).

***Fuel Characteristic Classes.*** The spread of fire depends largely on an ignition source, a sufficient amount of fuel, and conductive weather conditions (Sugihara 2006:38). Sandberg et al. (as cited in Sugihara et al. 2006:42) proposed a new system of fire characteristic classes that could help predict fire behavior, fire effects, and fire danger. These new classes are separated into six strata and are defined by vegetation types and also represent the potentially independent combustion environments. The six fuel characteristic classes are: tree canopy fuels, shrub fuels, low vegetation fuels, woody fuels, litter fuels, and ground fuels.

Tree canopy fuels. The tree canopy stratum contains overstory and understory fuels that lead to and sustain crown fires. The vertical distribution of the fuels provides a ladder for the fire to spread to the upper canopy. Aiding the spread of crown/canopy fires is forest density and wind speeds (Sugihara et al. 2006:43).

Shrub fuels. The shrub stratum is the percentage of spatial ground cover, vertically in height up to the live crown base, the mean shrub height, and the live to dead shrub ratio. Additional variables to consider in fire behavior include the heat content, moisture of extinction, the ratio of surface area to volume, and the load size class of both live and dead leaves and twigs. The most important variables in determining fire behavior for this stratum are mean shrub height and total fuel load (Sugihara et al. 2006:43).

Low vegetation fuels. The fuels that make up the low vegetation class include grasses, sedges, and other herbaceous soft stemmed plant varieties (non-woody stemmed). These fuels are classified by the ratio of surface area to volume and whether the plants are annual or perennial. The quantitative variables of grasses and sedges are their mean height, load, percent of cover, and maximum percent of live vegetation. These variables relate to fire behavior by determining moisture content as well as the packing ratio (Sugihara et al. 2006:43). The packing ration is the fraction of a fuel bed occupied by fuels, or the fuel volume divided by bed volume (NWCG 2009).

Woody fuels. This class of fuels includes downed trees, rotten logs, snags and stumps. Although sound logs contain moisture and tend not to contribute to surface fire spread they tend to burn slowly and smolder, which can contribute to soil effects, tree mortality and smoke. Rotten wood tends not to burn in the initial passing of the flaming front; rather, it smolders and adds smoke to the air. Finally, snags are dangerous to the spread of the surface fire if ignited due to their ability to launch glowing embers into the air, downwind, and downslope to ignite unburned fuels (Sugihara et al. 2006:43).

Litter fuels. Litter fuels include moss, lichen, pine needles, and leaves, and contribute to the spread of surface fires. Variables considered in this class include types of litter and its arrangement. The biomass of this fuel type is determined by mean depth and the percentage of ground cover (Sugihara et al. 2006:43).

Ground fuels. The ground fuels stratum is divided into the upper duff layer, lower duff layer, basal accumulation, and animal midden. Accumulations of these fuels under and around the bases of trees may smolder for days and may generate enough heat to contribute to tree mortality (Sugihara et al. 2006:43).

***Peak Temperature and Duration of Heating.*** The temperature and the length of duration of fire can have varied effects on cultural materials. The heat from fire can be transferred to the surface and subsurface soil through radiation, conduction, convection, and vaporization and condensation (DeBano et al. 2005:31).

Radiation is the transfer of heat without contact between one body and another through electromagnetic wave motion (Countryman 1976b as cited in DeBano et al. 2005:31). The radiated energy flows outward in every direction from the emitting substance where it encounters a material capable of absorbing the energy. That absorbed energy increases/excites molecular energy thereby increasing the temperature of the material (DeBano et al. 2005:31).

Conduction is the transfer of heat through molecular activity from one part of a substance to another part, or between substances in contact with each other, but without any substantial movement or displacement of the substances as a whole (Countryman 1976a as cited in DeBano et al. 2005:31). Dry mineral soils, wood, and air conduct heat slowly, while water and metals are very good conductors of heat (DeBano et al. 2005:31).

Convection is a mechanism by which heat is transferred from one point to another by the mixing of one portion of a fluid with another fluid (Chandler et al. 1991 as cited in DeBano et al. 2005:31). Convection can play an important role in the transfer of heat during a fire through above-ground fuels. However, in the soil subsurface, convection has little opportunity to transfer heat (DeBano et al. 2005:31).

Vaporization is the process of adding heat to a liquid up until that liquid transforms into a gas. Condensation occurs when the gas is changed into liquid form while releasing heat energy in the process. Vaporization and condensation work together as heat transfer mechanisms to facilitate the rapid transfer of heat through dry soils. Organic materials and water/liquids can move through the soil by vaporization and condensation (DeBano 2005:31).

***Soil Temperature Profiles***. During a fire, heat absorption and transfer produce elevated levels of temperature through the soil. The elevated temperature is the greatest at the surface and dissipates with depth from the surface. These temperature differences are called temperature profiles and can be highly variable depending mainly on water content and fuel types. Soils with less water tend to conduct heat less than soils that have higher moisture content (DeBano et al. 2005:34).

RNSP have three main surface fuels types: mixed grasses/prairie, brush, and timber/woodland. As discussed above, peak temperature and the duration of the heat can have adverse effects on cultural materials. Temperatures and durations of heating depend on the specific fuel type. Each of the three fuel types has a different peak temperature and time of duration of heating (see Table 2).

The first fuel type to consider during prescribed burns and wildfires are the mixed grasses. Grass fires tend to burn rapidly and at low temperatures (Buenger 2003). The combustion character of the brush fuel type varies with conditions, but it tends to burn at higher temperatures. During wildfires the entire plant canopy can be consumed within a matter of seconds, resulting in a large amount of heat being transferred into the soil. In contrast, a prescribed fire during more favorable atmospheric conditions can lead to a less explosive fire behavior that may be less destructive to the plant canopy and soil (DeBano

2005:35). Fires in the woodland fuel category vary in temperature and duration depending on the amount/depth of duff and the presence of larger fuels such as dead and downed trees. This fuel category has the potential for sustained temperatures that can adversely affect cultural materials.

**Table 2. Soil Temperature and Heating Duration.**

| Fuel Type | Peak Surface Temp | Resident Time | Sustained Heating |
|---|---|---|---|
| Mixed Grass | 100-300°C | 10-20 seconds | >50° for 3-6 minutes |
| Brush | 260-705°+C | ~5 minutes | >50° for 40+ minutes |
| Woodland (Duff/litter) | 200-400°C | 1-2 minutes | |
| Log | 400-800°C | 5-20 minutes | >300°C 20-40 minutes<br>100-200°C 2-4+ hours |

Adapted from Buenger 2003:312 and DeBano et al. 2005:35.

**Proximity of Resources to Fuels.** The effect of fire on cultural materials is largely a product of their proximity to fuel and, therefore, heat. Surface artifacts can be exposed to very high temperatures during fire events. However, as discussed above in the section on soil temperature profile, heat transfer tends to dissipate with depth from the surface; in this way affects on cultural materials are reduced. Artifacts up to a depth of approximately 20cm have been shown to be altered by fire (Jackson 1998:13). Buenger (2003:311) reported on a controlled experiment in which burning a log resulted in soil temperatures of 226°C at 2cm and only 105.7°C at a 5cm. Buenger concluded that in a coniferous environment, most cultural materials buried greater than 5cm were unlikely to be significantly affected by the fire (Buenger 2003:311).

**Temperature Ranges for Fire Effects on Cultural Resources**

Types of cultural resources are variously susceptible to heat. Organic materials often will be altered or destroyed in fires while minerals or other inorganic materials are more resistant to damage. However, even stone can be altered if the temperature and duration of the fire is sufficiently high. Most of what remains at prehistoric archaeological sites in RSNP are stone tools and waste material from tool manufacture. The following section discusses common cultural resource materials, emphasizing archaeological remains, and the temperature range at which they are affected by fire.

***Lithic Artifacts.*** Lithic artifacts and debitage are commonly found at prehistoric archaeological sites. They are generally the best preserved and can provide valuable data about prehistoric lifeways and culture history. Most lithic artifacts are either flaked stone or groundstone. The following sections on effects to lithic materials is based on information from Deal (2006).

The term flaked stone describes objects that functioned to cut, scrape, pierce, saw, hack, etch, drill, or perforate as well as the debitage or waste flakes that occur from the manufacturing of the flaked stone tools. Objects made of flaked stone include projectile points, knives, scrappers, drills, burins, gravers, choppers, saws, cores, flakes, fish hooks, and hand axes, among others (Deal 2006:1). These objects were commonly manufactured from chert, flint, obsidian, chalcedony, petrified wood, slate, quartz, quartzite, mudstone, siltstone, basalt, metamorphic rocks, and vitrified and welded tuff (Deal 2006:1).

Groundstone artifacts were used to pound, mash, pulverize, grind, or abrade minerals or plant and animal products. Groundstone objects include manos, metates, milling slabs, pestles, hammerstones, polishing stones, and fishing net weights, among others. These artifacts are often fashioned from granite, diorite, gabbro, basalt, andecite, rhyolite, greywacke, steatite, limestone, or sandstone (Deal 2006:1).

Some reported effects by fire on lithic artifacts include breakage, spalling, crazing, pot-lidding, discoloration, micro-fracturing, adhesions, altered hydration rims, altered protein residue, and weight and density loss (Deal 2006:2). Artifacts on the surface tend to be altered more than those below the ground due to direct exposure to fire and firefighting activities. Most research on thermal effects on flaked stone has focused on obsidian and chert (Deal 2006:2).

*Chert.* Prehistoric peoples thermally altered cherts (cryptocrystalline silicates) to improve its flaking quality. Cherts altered in wildland and prescribed fires have been reported to have external color changes, patination, cracking, crenulated breaks, pot-lidding, fracturing, shattering, and crazing (Deal 2006:4). Table 3 shows that although various sources of chert respond differently to temperature, most cherts fracture within a range of 350°C to 550°C.

**Table 3. Temperature and Thermal Effects on Chert (adapted from Deal 2006:6)**

| Temperature °C | Effect |
|---|---|
| 150 | Impurities may result in fracture |
| 121–400 | Changes in interior luster |
| 240–800 | Change in color on external surface |
| 350–400 | Distortion, brittle, or explosive |
| 350–550 | Fracture |
| 600–800 | Optical dulling of external surface |

*Obsidian.* Obsidian is a volcanic glass used prehistorically to make knives, projectile points, and many other tools. The source of an obsidian object can be determined through analysis of its chemical composition. Few studies have been conducted to analyze the affect of fire on the ability to determine the source of obsidian artifacts although Shackley and Dillion (2002 in Deal 2006:8) reported X-Ray Fluorescence (XRF) sourcing problems with thermally altered obsidian due to sands bonded onto the surfaces. Obsidian is also used by archaeologists is used as a dating tool. Over time, the newly exposed surface of a tool or flake absorbs moisture from the atmosphere, creating a hydration band. After considering the source, soil moisture, soil pH, and average temperatures from the site area, a formula is applied to the band measurement that may yield a relative date (Deal 2006:8). With this information, archaeologists can determine a site's chronology and stratigraphic integrity. Exposure to heat may alter the rim thickness or even destroy it completely (Deal 2006:9).

The thermal effect on obsidian varies with temperature and exposure time. Obsidian in fires with low fuel loads has a better chance of retaining the hydration rim compared to specimens in fires with moderate to high fuel loads (Deal 2006:9). Lab experiments and post-burn studies have reported alterations to obsidian that include fracturing, cracking, crazing, pot-lidding, exfoliation, shattering, oxidizing, pitting, bubbling, melting, discoloration, and surface residues (Deal 2006:7) See Table 4.

**Table 4. Thermal Effects on Obsidian Hydration Bands after One Hour of Exposure to Heat (adapted from Deal 2006:10)**

| Temperature °C | Change to Hydration Rim |
|---|---|
| 100 | Rim still distinct |
| 200 | Rim width increased slightly, still measurable |
| 300 | Rim diffuse and difficult to measure |
| 400 | Rim no longer visible; faint blue tint present at rim site |
| 500+ | Rim entirely gone |

Note: Change in the hydration rim can occur at lower temperatures if exposed for a longer time (e.g., hydration rim erased after heating for 12 hours at 200° C (Solomon 2002).

*Basalt.* Basalt is an igneous rock used prehistorically to make formal tools. Data specific to thermal effects on basalt are mainly restricted to post-burn observations from sites burned over in wildland fires (Siefkin 2001:np). Lentz (1996 in Deal 2006:12) noted thermal effects on basalt from a wildland fire to include sooting, pot-lidding, oxidation, reduction, crazing, luster changes, and adhesions. Like obsidian, basalt can also be sourced to its origin using XRF. Jackson and Tremain (1995 in Deal 2006:12) reported success sourcing basalt samples collected after a high intensity fire. Blood residue analysis has also been successful from basalt artifacts collected after high intensity fires. However, the researchers noted that thermoluminescence dates obtained from basalt exposed to fire may be as much as 24% too recent. The temperature thresholds for basalt are not well defined. In a laboratory experiment, however, Blackwelder (1927:137 in Deal 2006:12) indicates that a specimen of basalt began to spall flakes at 325°C.

*Groundstone.* Groundstone artifacts include pestles, mortars, handstones, milling slabs, fishing weights, milling slicks, and bedrock mortars. Typically, these items are fashioned from a wide variety of rock including granite, basalt, soapstone, schist, steatite, and sandstone. According to Siefkin (2001:n.p.), most data on the thermal effects of fire on these materials were post-burn observations from sites burned in wildfires. Thermal effects on these materials are affected by fire severity. Lentz (1996:33) reported that thermal effects to quartzite, rhyolite, and sandstone to included sooting, pot-lidding, oxidation, reduction, crazing, luster changes, and adhesions. These effects were noted from sites that had moderate to severe burning. Lentz (1996:33) also noted that sites that had light severity of burning had minimal thermal effects on surface groundstone artifacts. Outcrops and boulders which contain mortars and milling features have been reported after a wildfire to and include thermal effects such as blackening, sooting, cracking, spalling, and exfoliation (Deal 2006:14). Lentz (1996:63) suggested that palynological, microbotanical, and use-wear data could be affected by thermal exposure due to heat or surface loss.

*Shell.* Marine and freshwater shells occur in both prehistoric Native American sites and historic-era sites. Large shell-midden sites are common along the coast. Prehistorically, marine and fresh water bi-valves were used for subsistence, and their shells for beads and ornaments. In northern California, ornaments were fashioned from snail shells (Olivella sp.), abalone (Haliotis sp.), and other marine shells. In historic-era sites, marine or fresh water shells were used for buttons and are evidence of subsistence. Shell remains can reveal trade networks (ocean shell trading to inland peoples), they may be C-14 dated to determine site chronology, and may indicate subsistence strategies (Siefkin 2001:np).

Thermal exposure affects each variety of shell differently. Seabloom et al. (1991:n.p.) reported that a grass fire fractured or disintegrated shell on the surface. A study by Haecker (2000:12–14) reported on a shell button and a whole oyster shell that were exposed to relatively low (245°C) and then higher (815°C) intensity fire. At the lower temperature, the shell button discolored while the oyster shell appeared to be unaffected. The higher temperature completely calcinated the button while the oyster shell was only slightly discolored. Haecker noted that this difference in damage may have been due to the morphology of the smaller and thinner button compared to the larger whole shell. Siefkin (2001:np) noted that shell and shell ornaments were sometimes intentionally thermally altered to prepare the material for manufacture and prior to disposition (e.g., burned with cremation). These remains would exhibit discoloration and/or physical changes that reflect cultural behavior, and may be more vulnerable to further damage from heat.

*Bone.* Archaeological bone can reveal information on diet, tool use, behavior and health (e.g., human osteology studies), funerary practices, as well as site chronology. Bennett and Kunzman (1985:12) conducted laboratory experiments on fresh bone. Their work revealed that charring and breakdown occurred at relatively low temperatures with significant non-water weight loss at temperatures as low as 100°C. Bone exposed to temperatures of 300°C exhibited more charring and a chalky appearance, while temperatures above 400°C resulted in extreme chemical alteration and calcination. Burnt bone is more fragile and brittle than non-burnt bone although it will survive environmental conditions that will destroy unburned specimens. Steiner et al. (1995 in Siefkin 2001:np) conclude that the durability and mechanical strength of burnt bone was greatly lessened, especially at higher temperature ranges. Even subsurface bone can be affected by heat. Bennett (1999 in Siefkin 2001:np) performed an experiment in which he buried modern and archeological specimens of bone at a depth of 10cm. He then exposed the surface to low intensity heat (<500°C) for 84 hours. The specimens all showed color changes that are usually associated with much higher temperatures.

*Pollen and Archaeobotanical Remains.* Pollen and archaeobotanical materials can contribute important information about human adaptation and past environmental conditions (Shultz 2006:86). Fire can damage or destroy these materials. In a post-wildfire study, Scott (1990 in Siefkin 2001:np) observed that surface pollen was destroyed in moderate to high-intensity fire while subsurface materials were relatively unaffected. In a study resulting from the Long Mesa Fire, Fish (1990 in Siefkin 2001:np) reported that surface pollen was physically altered but could still be readily identified.

While certain depositional contexts can preserve archaeobotanical remains (e.g. caves, rockshelters, or bogs), most of these remains will not be preserved unless carbonized (Micsicek 1987:219). Carbonization of plant materials occurs between temperatures of 250 to 500°C in low oxygen conditions. Carbonized plant remains are resistant to further decay but can be mechanically damaged from compression. Ford (1990 in Siefkin 2001:np) reported that a wildfire did no apparent damage to botanical remains collected from shallow hearths during the La Mesa Fire.

*Wooden Features and Artifacts.* Wood such as redwood was used by Native Americans to construct houses and ceremonial buildings, as well as canoes and tools including bows, and arrow and spear shafts. However, wood is rarely preserved in prehistoric archaeological contexts unless waterlogged or in an extremely arid setting. In historic-era sites, such as the Dolason ranch, lumber was used to construct a range of buildings, fences and other structures, as well as miscellaneous tools. Haecker (2000:2) reported that although the rate of wood charring depends on many factors, cut lumber will ignite at around 350°C. Haecker also reported that wood from historic-era contexts will often ignite at lower temperature fires due to decomposition from weathering and proximity to fuels such as vegetation.

*Vegetation.* Culturally modified trees and examples of exotic and managed vegetation can be found in RSNP. Black oak trees are commonly found in close proximity to mid-elevation habitation sites, suggesting that these trees were used and tended by Native populations (Siefkin 2001:n.p.). In the Williams Ridge area of the Bald Hills FMU patches of camas and hazel were introduced, tended, and harvested under a millennia-long Native American land management regime (NPS:2004b:7). Historically, trees were planted for windbreaks and on property lines. Apple, cherry, walnut, and pear trees were planted on farms. Introduced annual and perennial flowers are commonly found in historic-era habitation sites.

The potential for fire to affect trees is related to their condition and health, the surrounding fuel load, and the method of ignition (e.g., aerial vs. ground) (Siefkin 2001:np). Tree ring data are invaluable for paleoclimatic and paleoenvironmental reconstruction. Fire history can also be researched from standing groves and stumps of certain species of trees (Siefkin 2001:np). Data derived from Giant Sequoia and standing stumps in the southern Sierra Nevada are critical to understanding fire history and climatic changes (Swetnam 1993 in Siefkin 2001:np). Trees may be important aspects of the historic landscape.

*Cement, Brick, and Cinder Block.* These materials are often found in association of historic-era archaeological sites. In a study on fire effects to these types of building materials, Haecker (2000:7) reported that porous brick is highly susceptible to fire. Furthermore, cinder block, certain masonry surfaces, and cement mortar may spall when exposed to heat. Fire temperature affects materials gypsum plaster, firebrick, and cement mortar in different ways. A temperature of 245°C was found to discolor gypsum plaster and cause the material to become friable; firebrick and cement mortar appeared to be unaffected. At temperatures exceeding 650°C, firebrick became discolored and broke apart, the gypsum plaster became even more friable, and the cement mortar became discolored (Siefkin 2001:np).

*Historic-era Ceramics.* Ceramic artifacts are often found at historic-era habitation sites. Haecker (2000:7) stated that fire can affect these materials depending on the paste, glaze, painted surfaces, and the temperature to which the material is exposed. Refined earthenwares will crack and become discolored when exposed to relatively low temperatures. Porcelain overglaze and painted decorations as well as makers' marks can become discolored or eliminated when exposed to fire; however, the melting temperature of porcelain is a relatively high 1550°C (Siefkin 2001:np).

*Glass.* Bottle glass and other glass artifacts are common on historic-era habitation sites. They can be used to date the site and help determine its function (Siefkin 2001:np). Window glass thickness measurements have been used as a temporal indicator. Flaked glass artifacts have been recovered from Native American sites at various localities (not within RNSP). Glass type, bottle shapes, manufacturing processes (e.g., seams and thickness), as well as makers' marks can be temporally diagnostic. Lead glass has a melting point of 420°C; soda lime glass, pressed, and brown-ware glass have a melting point of 540°C (Siefkin 2001:np).

*Historic-era Metal.* A wide variety of metal artifacts are commonly associated with historic-era sites including cans, nails, animal shoes, coins, tools, and utensils. Metal found in archaeological sites may be affected by temperatures from 135°C to 1500°C (Table 5). The melting points of some metals may be reduced by alloying Haecker (2000:10–12). Under this process, the lower temperature metal drips onto the higher temperature melting metal and results in a reaction which causes the latter to melt. Furthermore, some metals warp when heated (Haecker 2000:10-12).

Trash burning was commonplace at historic-era sites. Although in many cases it appears that these temperatures were not sufficient to damage the metal, certain components (e.g. lead solder in cans) may melt causing loss of the artifacts' structural integrity and hastening disintegration (Haecker 2000:11). Thermal shock may also damage the material. This is achieved through heating the metal and then exposing it to water, causing it to rapidly cool (Siefkin 2001:np).

**Table 5. Melting Point Temperatures for Historic-era Materials (adapted from Haecker 2000 as cited by Siefkin 2001:np)**

| Material Type | Temp. C | Artifact Type |
|---|---|---|
| Solder (tin-alloy) | 135–177 | Patch repair on brass and iron objects |
| Tin | 232 | Kitchenwares, toys, building materials |
| Pot metal (copper-lead alloy) | 300–400 | Flatwares, pots, faucets |
| White pot metal | 300–400 | Kitchenwares |
| Lead | 327 | Bullets |
| Zinc | 375 | Plating for iron objects |
| Glass | 593–1427 | Insulators, bottles |
| Aluminum | 660 | Kitchenwares |
| Brass (yellow) | 932 | Cartridge cases, military buttons and insignia |
| Silver | 960 | Coins and jewelry |
| Gold | 1063 | Coins and jewelry |
| Copper | 1082 | Kitchenwares, building materials, coins |
| Cast Iron | 1350–1400 | Kettles, Dutch ovens, wood stoves |
| Steel (stainless) | 1427 | Eating utensils, kitchenwares |
| Nickel | 1455 | Plating |
| Steel (carbon) | 1516 | Heavy machinery parts |
| Iron | 1535 | Tools, nails, horseshoes, cans, roofing |
| Porcelain | 1550 | Insulators, kitchenwares, toilets |

## Operational Effects of Fire Management

Operational effects generally are associated with wildfires but can also occur during prescribed burns. Cultural resource managers need to be aware that there is a high potential for damage to cultural resources from the implementation, control and/or suppression of wildland fires (Pyne et al. 1996 in Siefkin 2001:np).

Operational activities that could cause damage or adverse effects to cultural resources include ground disturbing activities such as establishing staging areas, construction of fire lines, excavation of hand lines, widening trails and roads, chemical retardant drops, the presence of human activity and noise that may affect Native American traditional activities, unauthorized collection of artifacts and disturbance of extant buildings by fire fighting personnel. Creating or improving trails facilitates access to areas that may contain resources that otherwise would be inaccessible. The following sections are based on fire management activities has been summarized from information provided by Siefkin (2001).

### Ground Disturbance

***Staging and Access.*** Staging for the management of wildfire and prescribed fires involves distributing vehicles, equipment, and personnel before, during, and after a fire event. During a prescribed fire event, the numbers of personnel and equipment is fairly low compared to wildfires. The prescribed fire units are often staged close to developed areas in previously developed areas such as roads, pullouts, and parking lots. Vehicles are parked in these locations and equipment is readied. Ground disturbances occur in these areas; however, this is usually very shallow. All terrain vehicles, equipment and personnel are employed on previously constructed fire lines to access the burn unit. Trails are often used to access the interior of the remote burn unit (Siefkin 2001:np).

Spike camps are placed at established backcountry camps for field personnel. In the event that a backcountry camp area is unavailable for a spike camp, one will be established in an optimal location. Ground disturbing activities at these camps would include increased foot traffic and excavation of latrines as well as pits for gray water disposal. A heli-spot or drop point is often created on flat, open areas. This may require vegetation removal (Siefkin 2001:np).

Staging for wildfire conditions is frequently more complex and urgent, and includes more equipment and people. While in most cases equipment is driven and parked in designated/and or previously disturbed areas, the increased quantity of equipment and personnel may adversely affect cultural resources. Large temporary base camps are often used to house fire personnel. They are usually located some distance from the fire in parking lots or campgrounds. Spike camps are established on the margins of the burn. Heli-spots or drop points are constructed as needed. Safety zones are established along the perimeter of the burn if vegetation free zones do not exist. This is done to protect fire personnel in the event of extreme fire behavior. Safety zones can be hundreds of square meters in size and are cleared of all standing and ground fuels with hand tools (Siefkin 2001:np).

***Fire Lines.*** Fire lines are breaks in fuel continuity: handlines, scratch lines, dozer lines, wetlines, and foam lines (Table 6). *Handlines* are fire breaks constructed using shovels, hoes, saws, and chainsaws. *Scratch* lines are used for a quick fire break in an initial attack and later improved to aid in the fire containment. *Catline* fire breaks are constructed with tracked vehicles such as bulldozers (Siefkin 2001:np). Catlines can cause substantial ground distance and have a high potential for adverse effect to cultural resources. For example, a catline was established for a firebreak in the July 2008 Motion Fire near the Whiskeytown National Recreation Area. In constructing the line, CAL FIRE dozed through an unrecorded prehistoric archaeological site. In his site assessment, Allen (2009:36) noted that an estimated 131 square meters (approximately 55%) of the site's top 10cm surface had been disturbed. More examples of these effects are provided by Keefe et al. (1999), and Wettstaed and LaPoint (1990). *Wetlines* are constructed by laying down a strip of water on fine fuel. *Foam lines* are generally comprised of chemically fire retardant foams (Siefkin 2001:np).

**Table 6. Types of Fire Lines.(adapted from Siefkin 2001:np).**

| **Fire line Type** | **Method of Construction** |
|---|---|
| Handline | Fire line put in by hand labor |
| Scratch line | Preliminary handline used in initial attack and later improved |
| Dozer line | Fire line constructed by tracked vehicles |
| Wetline | Fire line made of a strip of water on fine fuels |
| Foam line | Line made with chemical foam |

***Ignition Techniques***. Various ignition patterns are employed when conducting prescribed burns and to suppress wildfires. These techniques have varying implications for cultural resources depending on temperature and intensity. *Heading* fires are those set to burn upslope or with the wind. In general, these fires tend to burn at high intensity with high spotting potential. *Backing* fires are usually employed along a fire line or road and are allowed to burn downslope or against the wind. Backing fires are generally of a lower intensity, have slow spot potential, and spread slowly. *Flanking* fires provide a means to keep flame heights between the levels of heading and backing fires but require coordination between the many individuals who ignite strips that form a series of widening triangles or chevron patterns. Finally, *center* or *ring* fires involve the ignition of a central area, and then surrounded by concentric circles/rings of fire from the central ignition area. This type of ignition source burns at a high intensity level in heavy fuel loads (Siefkin 2001:np).

Ground and aerial ignition of fuels are commonly used in northern California. Generally, ground ignition is accomplished through the use of fuzzes, drip torches, flame throwers, and terra-torches. In aerial ignitions, plastic sphere dispensers and heli-torches are used. The plastic spheres are filled with jellied gasoline and, if dropped directly onto a site, could cause higher intensity burning (Siefkin 2001:np).

**Retardant Drops**

Fire retardants have been successfully employed to protect cultural resources from the direct effects of fire. Two types of fire retardants are used in both wildfire and prescribed burns: chemical agents and physical agents. Physical agent influence heat and diffusion processes, while the chemical agent affects fuels by modifying the course of combustion (Siefkin 2001:np).

The operational effects of fire retardants on cultural resources relate directly to the application and composition of those retardants. Backpack pumps, fire hoses, and aircraft are used to apply fire retardants. Retardant drops from higher elevations could have adverse effects on cultural resources by toppling standing structures or affecting the ground by eroding midden or scattering artifacts (Siefkin 2001:np).

Chemical retardants may adversely affect historic-era wooden structures and historic-era metal in mining and logging equipment. These retardants should only be used in case of emergency. Long-term retardants contain fertilizer salts that affect the color of wood and can attract water, causing the wood to swell then contract. Some retardants contain corrosion inhibitors that can cause metallic surfaces to change color (USFS 2002).

**Looting**

Although looting on the part of fire crews is a documented threat during prescribed fires and wildfires, in many cases personnel are extremely receptive to information about the importance of protecting cultural resources (Traylor et al. 1990:103–104). Cultural resource managers must balance the protection of sensitive cultural resource information with the necessity to inform fire crews about the resources they should protect (Siefkin 2001:np).

**Noise and Other Effects**

Fire and fire management activities can affect the integrity of feeling and setting of cultural landscapes and other historic properties. Noise pollution caused by heavy machinery or chainsaws, and the mere presence of fire fighters, helicopters and airplanes flying over TCPs may affect the use and the importance of these properties, as the use are determined by the people who use and value them. A recent Associated Press article addressed the concerns of Klamath area tribal groups over U.S. Forest Service (USFS) fire management policies (A.P. 2008). The Native American groups favored letting a natural wildfire take its course, but when USFS brought in drip torches to manage the blaze, a tribal member commented that "it's like taking drip torches to the Vatican or Mount Sinai" (A.P. 2008).

This case exemplifies the importance of consulting with concerned Native Americans tribes before initiating prescribed burns and during wildfire events on or near TCPs or other important places.

## INDIRECT EFFECTS OF FIRE AND FIRE MANAGEMENT

Indirect effects on cultural resources from fire and fire management activities include: increased erosion of archaeological sites due to the loss of vegetation, increased potential for visitors to remove artifacts and vandalize standing buildings and structures; increased tree mortality due to fire; introduction of carbon contamination into archaeological deposits; and the introduction of invasive, non-native plant species.

### Erosion

Fire management activities may affect cultural resources due increased runoff and erosion following a fire. Robichaud et al. (2000:5–11) conclude that only 2% of annual rainfall turned into runoff on soil with good hydrological conditions and with ground vegetation of 75% or higher. Under these types of conditions, the vegetation holds the soil in place, reducing erosion. In the severe circumstances attendant on moderate to high intensity fires, ground cover was reduced to less than 10% coverage. This resulted in 70% increase in runoff and a 300% increase in soil erosion. These effects to soils could be increased in the event of rain closely after the fire.

In a study from the Chamise Experimental Pastures in northern California, soil movement was found to be significantly greater on burned areas than unburned. The amount of soil movement was directly related to slope (e.g., the greater the slope, the greater the erosion). Similar results were reported in a study near Ukiah, California (Hoyer 1982:24).

The increased soil erosion is due to changes in soil structure from fire effects. First, the soil structure collapses and the density is increased because the organic matter that bound the soil together was destroyed. This collapse of soil reduces the soil porosity. The soil is further compacted by raindrops when surface soil and ash are displaced, resulting in surface soil pores that are partially or totally sealed. Finally, this impenetrable soil surface reduces the amount of absorption of water into the soil, thus producing rapid runoff and hill-slope erosion (DeBano et al. 2005:31).

**Looting and Vandalism**

RNSP receives a great deal of public use annually. Following a prescribed burn or wildfire previously inaccessible cultural resources prior may suffer from increased looting and vandalism. Many visitors are unaware that removing artifacts from federal land is against the law. Furthermore, the public may inadvertently damage cultural materials on the surface. Siefkin (1999:3) notes that these effects have not been systematically examined, although the problem undoubtedly varies with the resource and vegetation type as well as the local fire behavior. For example, prescribed fires in forested areas often do not appreciably increase the danger to lithic scatters; whereas historic-era artifact concentrations and architectural features do become far more noticeable.

**Tree Fall**

Fire may cause tree death or tissue damage resulting in a weakened tree that may later succumb to disease and insect infestations. Tree mortality may affect cultural resources. Trees killed outright during the fire may fall and, in falling, may uproot artifacts by the root mass and harm a site's stratigraphic integrity.

Artifacts, buildings, and structures may be crushed by falling trees. Fallen trees add to the full load and burn at extreme temperatures in a fire. Shultz (2006:) noted that some trees are part of the historic landscape or may be elements of a TCP. Damage to these trees could compromise the integrity of the site.

Damage from tree fall to cultural resources occurred during a wildfire event in Sequoia and Kings Canyon National Park in 2003. Hamm and Burge (2003:3) noted that even after protecting a historic cabin from fire by constructing firebreaks, a nearby tree that had burned outside of the firebreak perimeter subsequently fell onto the building and damaged it.

**Carbon Contamination**

The contamination of archaeological sites and features, such as hearths, from intrusive, non-cultural botanical remains is of concern. Contaminated charcoal samples submitted for C-14 dating will yield deceptive data. The contamination of recent plant remains may lead researchers to false conclusions regarding the paleoenvironment (Siefkin 2001:np).

Researching carbonized botanical remains from the La Mesa Fire, Ford (1990 in Siefkin 2001:np) notes that the cultural and natural (recent) charcoal samples were easily distinguishable. The cultural charcoal exhibited no textural or color differences but was more friable. The natural charcoal was harder and was often scorched on only one surface. However, Ford's samples collected relatively soon after the area had burned. As time passes, non-cultural charcoal may be harder to distinguish from archaeological. Furthermore, the newer sample may remain in the soil matrix for a longer time because of its hardness. Additional contamination could occur as charcoal is mixed into the site matrix by rodents, erosion, and expansion and contraction of the matrix due to heating and cooling.

**Invasive Species**

The establishment of non-native species following wildfires can pose a threat to long term native plant recovery. Fire regimes and forest structure have changed dramatically due to nineteenth and twentieth century management practices. Fuel loads have been increasing while wildfires have been repressed, resulting in infrequent large and severe wildfires which can be directly correlated to adverse ecological effects (Siefkin 2001:np). These effects can include increased tree mortality, reduced understory plant cover, and increased mortality of soil seed banks. The resulting incidence of exposed bare soil and low tree canopy creates a high potential for non-native species, increased water runoff, and soil erosion in the post-fire environment (Hunter et al. 2006:271). Prescribed fires can result in wholesale shifts in vegetation communities, e.g., sagebrush to grassland (Siefkin 1999:4).

Losing native vegetation is a cause for concern. Native Americans have traditionally collected seeds, acorns, and utilized other plants for basketry and other tools in REDW (NPS 2004b:np). Some of these locations may qualify as traditional cultural properties. Historically, the annual burning of grassland insured new growth. However, with the influx of invading species comes the potential for native plants to be replaced with non-native. This may result in the decline of traditional collecting practices and negatively affect local Native American culture.

The next chapter relates to the effects of fire because it describes the Fire Management Units (FMUs) located at RNSP. Each of these FMUs contain different fuel types, terrain, cultural resource types, and management objectives.

# CHAPTER 5. REDWOOD NATIONAL AND STATE PARKS FIRE MANAGEMENT UNITS AND FIRE MANAGEMENT PLANNING

This section describes the fire management units (FMU) of RNSP as well as the values in each unit (including cultural values) that fire management policies are intended to protect. A FMU is a land management area definable by RNSP's objectives, management constraints, values to be protected, political boundaries, topographic features, access, fuel types, major fire regime groups, etc. that set it apart from the characteristics of an adjacent FMU. The FMU may have dominant management objectives and pre-selected strategies assigned to accomplish these objectives (NWGC 2009:np). The following text has been taken verbatim from the 2010 DRAFT Fire Management Plan (NPS 2010). The information contained in FMU descriptions are important to help understand the types of fuels found in each of the different FMUs.

## CONIFEROUS FOREST FMU

The coniferous forest FMU in RNSP includes areas of old growth redwood forest, 2$^{nd}$ growth forests, and Sitka spruce forests. This FMU encompasses a large portion of the southern area of the park, the majority of it located in the Redwood Creek drainage. Smaller pockets of this FMU are scattered between the three state parks which are located north of Prairie Creek State Park (PCSP). The coniferous forest FMU of RNSP occupies a total of approximately 67,980 discontinuous acres. The following section specifically details the vegetation which defines this FMU (NPS 2010).

**Old Growth Redwood Forest (19,537 acres)**

The old growth redwood forest most dominant species is the coast redwood *(Sequoia sempervirens)*. Associated species depend on local conditions such as whether a site is upland, riparian, alluvial, or coastal. Other coniferous trees include Douglas-fir *(Pseudotsuga menziesii* var. *menziesii)*, grand fir *(Abies grandis)*, Sitka spruce *(Picea sitchensis)* in lowland and coastal areas, and western hemlock *(Tsuga heterophylla)* in moist habitats. Conifers other than redwood may be the dominant species in some forest stands where soil, temperature, moisture, and salty sea-spray favor the other vegetation (NPS 2010).

In riparian and upland areas of the FMU, hardwoods occasionally dominate a stand. These hardwoods include tanoak *(Lithocarpus densiflora var. densiflorus)*, madrone *(Arbutus menziesii)*, big leaf maple *(Acer macrophyllum)*, California bay or laurel *(Umbellularia californica)*, and red alder *(Alnus rubra)* (NPS 2010).

The moist lower slopes have the lushest understory found in redwood forest communities. The most dominant understory species of the redwood forest are oxalis *(Oxalis oregana)* and sword fern *(Polystichum munitum)*. Other common understory plants are rhododendron *(Rhododendron macrophyllum)*, huckleberry *(Vaccinium* spp.*)*, salal *(Gaultheria shallon)*, azalea *(Rhododendron occidentale)*, and several types of berry *(Rubus* spp. and *Ribes* spp.*)*. The middle and upperslope areas of the redwood forest are characterized by evergreen shrubs (salal, rhododendron, and huckleberry) (NPS 2010).

**Second Growth Forest (46,582 acres)**

The second-growth forests in RNSP are mainly dominated by Douglas-fir. This coniferous tree species, a native component of the redwood forest, was seeded into many logged areas after tree harvesting. The seed mix contained primarily off-site Douglas-fir and, in some cases, included other exotic conifers. The seeding of Douglas-fir into open clearcut areas, allowed this species to take full advantage of available growing conditions. Although redwood trees often stump sprout or seed into moist areas, the sheer number of Douglas fir seeded into the clearcut areas subordinates redwoods and its natural dominance. In stands that were not aerially seeded after the logging harvest, there are differences in the species composition that did not exist previous to logging. Douglas-fir and grand fir seedlings survive much better on dry, open sites than redwood seedlings. Fir species thrive in forest openings, whether they are natural openings or large areas drastically disturbed by logging operations (NPS 2010).

***Dry Forests* (44,987 acres)**

The dry forests in this FMU include mixed evergreen forests in the Redwood Creek basin and occur along ridges from Slide Creek to Coyote Creek. This type of forest is dominated by Douglas-fir, madrone , and tanoak. California bay, bigleaf maple, chinquapin *(Chrysolepis chrysophylla)*, canyon live oak *(Quercus chrysolepis)*, and poison oak *(Toxicodendron diversilobum)* are also common in this forest region. The shrub understory can be thick and impenetrable in many locations (NPS 2010).

*Alder forest* **(263 acres)**

The alder forests are located primarily on western facing slopes and in 2nd growth forest locations. Red alder is the dominant overstory tree, but is usually found mixed with big leaf maple, cascara (*Rhamnus purshiana*), willow (*Salix* spp.) and coniferous trees. The understory is dominated by berry species including salmonberry (*Rubus spectabilis*), thimbleberry (*Rubus parviflorus*), blackberry (*Rubus* spp.), red elderberry (*Sambucus racemosa*), and twinberry (*Lonicera involucrata* var. *ledebourii*). The herbaceous layer typically includes sword fern, lady fern (*Athyrium filix-femina*), colt's foot (*Petasites frigidus* var. *palmatus*) and false lily of the valley (*Maianthemum dilatatum*) (NPS 2010).

***Riparian* (731 acres)**

The riparian vegetation in the FMU is restricted to alluvial bottoms and stream banks which are subject to frequent flooding and perennial water. Riparian vegetation is widespread throughout the parks, forming extensive stands along the lower Klamath River, Smith River, Mill Creek, Redwood Creek, and Prairie Creek. This vegetation is usually dominated by big-leaf maple, black cottonwood (*Populus balsamifera* spp. *trichocarpa*), California bay, red alder as well as various willow species (NPS 2010).

**Sitka spruce forest (1125 acres)**

The Sitka spruce forest area is located along the coast between the redwood forest and the Pacific Ocean. The forest can be distinguished by the dominance of Sitka spruce in the overstory, usually with some western hemlock and redwood. The older Sitka spruce often has a variable understory. The understory includes evergreen huckleberry (*Vaccinium ovatum*) and salal on drier locations. In the more moist areas, the vegetation is dominated by sword fern, lady fern, false lily of the valley and skunk cabbage (*Lysichiton californicum*) (NPS 2010).

**Values to be protected in the Coniferous Forest FMU**

According to the Fire Management Draft (2010), there are five specific values/goals which need to be protected from fire and fire management activities in the Coniferous Forest FMU(NPS 2010). These five values are:

1) Protect the old growth redwood trees and associated biota.
2) Protection of the Little Lost Man Research Natural Area.
3) Protection of the riparian corridors, with special attention to streams around the habitat for threatened or endangered salmoniod fish species.
4) Protection of the habitat of the endangered/threatened for birds species such as the northern spotted owl and marbled murrelet.
5) Protect the visual quality of the FMU.

**COASTAL FMU**

The coastal FMU at RNSP is located along the entire length of the coastal strip of RNSP, excluding the areas designated in the State Park FMU. The vegetation of the FMU includes dune mat vegetation, dense shrub vegetation growing on slopes immediately adjacent to the coastal plain, and coastal grassland intermixed with the scrub. The coastal FMU is made up of approximately 6,237 acres in the national park in four disjunct areas. The following section details more specifically the vegetation found in this FMU (NPS 2010).

**Coastal Strand and Scrub (2273 acres)**

Coastal vegetation types in the FMU include dune mat vegetation and coastal scrub. Coastal vegetation is subject to wind and salt spray and the sandy soils are well drained and potentially unstable. Some areas exhibit wind pruning due to the relentless, strong winds of the coast. Layia (*Layia carnosa)* is a rare and endangered plant species found along the coastal strand (NPS 2010).

The coastal strand along the western edge of RNSP is dominated by low-growing salt-tolerant plants like sand verbena (*Abronia latifolia*) and the invasive alien European beachgrass (*Amophila arnenaria*). This vegetation may be washed by storm waves during winter high tides (NPS 2010).

Sand dunes sometimes can occur at Crescent Beach but are more common at Freshwater Lagoon beach. Vegetation which grows on dunes along the ocean is subject to incessant desiccating, salt-bearing breezes. The shifting sands around alien European beach grass become invaded by species tolerant of sand cover, allowing those species to spread over larger areas and stabilize those areas. This process creates a suitable habitat for species that are not tolerant of sand burial. In some of the coastal areas, succession is visible as beach grasses on dunes are being invaded by lupine (*Lupinus* spp.), coyote brush (*Baccharis pilularis*) and Sitka spruce on the back dunes (NPS 2010).

Coastal scrub generally occupies a narrow strip of land between dunes and the coastal coniferous forest. Coastal scrub vegetation can exhibit wind pruning and may take on a low or prostrate form. Coastal scrub vegetation areas are dominated by evergreen shrub species, wind-pruned trees, and/or low-growing shrubs intermixed with herbaceous species and grasses. The most common species include Coyote brush, salal, salmonberry, lupine, and oceanspray *(Holodiscus discolor).* The most common wind-pruned trees in the coastal scrub are Sitka spruce and red alder (NPS 2010).

**Coastal Grasslands (547 acres)**

The grasslands in the coastal FMU typically occur within one mile of the ocean. Grasslands or prairies occur at Major Creek, Deer Meadow, Flint, Lincoln, DeMartin, Crescent Beach, and Ossagon. Some of these prairies may have be native to the coast and were potentially used by and burned by the native American groups whose pre-historically inhabited the area. Origins for other prairie areas may have be influenced when early settlers cleared conifer forests for settlement or mining. Many of these grasslands areas have diminished in size due to the modern disturbance and absence of fire which has accelerated successional processes that favor woody species. The dominant species in the grasslands are perennial grasses with shrubs and/or hardwood/coniferous forest extending beyond the open grass. Ossagon, Lincoln, and Deer Meadow are located within the state park FMU; restoration of the cultural landscape associated with the Yurok village of Osegen is addressed in the State Parks FMU (NPS 2010).

**Values to be protected in the Coastal FMU**

According to the Fire Management Draft (2010), there are four specific values/goals which need to be protected from fire and fire management activities in the Coastal FMU(NPS 2010). These four values are:

1) Protection of cultural resources and cultural landscapes.

2) Protection of endangered plant species.

3) Protection of wildlife habitat.

4) Protect the visual quality of the FMU.

## LITTLE BALD HILLS FMU

The Little Bald Hills area of RNSP includes open grassland, woodland, shrubland, and coniferous forest. This FMU can be found east of Jedediah Smith Redwoods State Park on steep slopes and broad ridges ranging in elevation from 500 to 1200 feet elevation. The area is approximately 10 miles from the ocean. This FMU occupies approximately 1,500 acres within the national park. The following details more specifically the vegetation found in this FMU.

### Serpentine Vegetation (1492 acres)

The Jeffrey pine/chaparral/knobcone pine vegetation community includes several distinct vegetation types localized in the Little Bald Hills. Despite almost 100 inches of annual precipitation here, this area has sparse vegetation due to serpentine soils, which have high concentrations of heavy metals such as magnesium and few nutrients available for plants because of high pH and poor water holding capacity. These harsh growing conditions have resulted in the development of specialized plant communities with many unique plant species.

The driest ridgetops are occupied by widely scattered Jeffrey pine *(Pinus jeffreyi)*, with an understory of Idaho fescue (*Festuca idahoensis*). The fringes of this area are being rapidly encroached by Douglas-fir. Openings in the driest areas are diminishing due to regeneration of Jeffrey pine. A chaparral vegetation type is located downslope of the Jeffrey pine and is dominated by manzanita *(Arctostaphylos* spp.*)*, golden chinquapin *(Chrysolepis chrysophylla)*, rhododendron, huckleberry oak *(Quercus vaccinifolia)*, a shrubby form of tanoak (*Lithocarpus densiflorus* var.*echinoides*), and other evergreen shrubs, interspersed with stands of knobcone pine *(Pinus attenuata)*. Port-Orford-cedar *(Chamaecyparis lawsoniana)* can be found here.

The knobcone pine vegetation type in the parks is a dense forest of small-diameter, mostly even-aged pines. Knobcone pines may be restricted to serpentine soils and are subject to frequent fires because of their association with other fire-dependent vegetation, xeric growing conditions, and early senescence, which adds to the fuel layer. Knobcone forest is a successional stage that in the absence of fire gives way to Douglas-fir, madrone, and tanoak. Based on tree fire scar examination and post-fire regeneration, the last known fire in the knobcone pine vegetation type was about 1940.

On the lower slopes of the western portion of this FMU, second growth redwood and Douglas-fir forests dominate the vegetation types. This area was logged around 1955. Redwood, Douglas-fir, Port-Orford-cedar, and tanoak dominate the overstory with rhododendron, huckleberry, and salal dominating the understory. A few small stands of old growth redwood forest extend into the unit from the west and south, but are mostly restricted to drainages.

Values to be protected include:

1) Rare plants, including habitat for an endangered butterfly (the mardon skipper)
2) Vegetation type that is unique in the parks and is thought to be fire-dependent

Management Considerations in this unit include:

3) Adjacent Forest Service land
4) Shallow soils susceptible to disturbance from suppression actions
5) Port-Orford-cedar root disease

**Response to Wildland Fire**

Fires within this FMU may be managed for resource benefit.

**Preparedness activities in the FMU will include the following project:**

**Water Storage Development**

A polyplastic 2,500-gallon tank will be placed within the FMU to provide a reliable water source during suppression and prescribed fire incidents. Tank site preparation will be minimized by using an already established foundation where the old repeater was located. If that is not a suitable site then a platform made from milled redwood would be built to hold the tank. The redwood platform would be no more than two feet tall and built to conform to appropriate engineering specifications.

**Water Tank sites for this FMU include:**

| | |
|---|---|
| Little Bald Hills | Rain Filled |

**Prescribed Fire**

*Little Bald Hills Unit:* The entire 1500 acre Fire Management Unit will become the Little Bald Hills Prescribed Fire Unit, with the goal of not treating more than 50 acres every two years.

**Mechanical Fuels Reduction**

*Little Bald Hills Unit Mechanical Preparation:* This project will reduce fuel loadings along unit perimeter and reduce stand densities within interior portions of the unit in preparation for later prescribed fire.

**Bald Hills FMU**

The Bald Hills area of RNSP includes open grassland and Oregon white oak woodland, and areas of encroaching conifers that invaded the edges of the grasslands and oak woodlands after intentional burning by Native Americans and livestock ranchers ceased by the early 1900s. This FMU can be found in the southeast corner of the park along the major ridge divide between the Klamath River and Redwood Creek. The area is approximately 10 to 20 miles from the ocean and occupies approximately 5043 acres within the park. The following details more specifically describe the vegetation found in this FMU:

**Bald Hills Grassland/Oak woodland (4200 acres)**

The most extensive grassland/woodland vegetation type in the parks is located in the Bald Hills, on and below the eastern watershed divide of Redwood Creek. Balds are a distinct vegetation type as identified by Holland (1986) but the term "Bald Hills" in the national park includes a complex mosaic of vegetation types including grassland, Oregon white oak *(Quercus garryana* var. *garryana*) woodlands, and coniferous forest. The Bald Hills include about 1,700 acres of Oregon white oak woodland and 2,500 acres of grassland. Based on historical information and published sources, park botanists believe that prairies and oak woodlands existed in the Bald Hills prior to the arrival of American Indians 5000 years ago, although the extent and distribution of the prairies and woodlands are unknown. The contemporary extent of the Bald Hills grasslands is likely determined by a number of factors, including soil type, slope, aspect, landform position, present and past climate, plant succession processes, and fire history.

The Oregon white oak is the dominant oak species in the Bald Hills with scattered individuals of California black oak (*Quercus kelloggii*). Seven plant associations have been described in these oak woodlands (USDI 1987). In general these woodlands can be associated with California bay, madrone, and big-leaf maple near rock outcrops and stream channels. Shrubs can also be found growing in rockier sites, while in most other areas, the understory is typically herbaceous and dominated by grasses and forbs. Oregon white oaks can be found from 3000 feet at Schoolhouse Peak to 700 feet along Redwood Creek. These woodlands are vulnerable to encroachment by woody species and prescribed burning has been one of the primary tools used by park staff to manage the area since the mid-1980s.

Native grasses and forbs make up half of the species in the grasslands of the Bald Hills, but nonnative grasses predominate in cover. Three native species are common: a sedge *(Carex tumicola)*, California oatgrass *(Danthonia californica)*, and blue wildrye *(Elymus glaucus)*. The most common nonnative species are tall oatgrass *(Arrhenatherum elatius)*, sweet vernal grass *(Anthoxanthum odoratum)*, velvet grass *(Holcus lanatus)*, dogtail *(Cynosurus echinatus)*, soft chess *(Bromus hordeaceus)*, plantain *(Plantago lanceolata)*, and sheep sorrel *(Rumex acetosella)*. The most westerly grassland in the Bald Hills is Gans Prairie, roughly 5 miles from the coast, and the most easterly is upper Coyote Creek Prairie, approximately 15 miles from the coast. These grasslands are also vulnerable to encroachment by woody species. Prescribed burning has been one of the primary tools for managing these grasslands since 1980.

Humans have had a profound influence on the ecological processes thought to have perpetuated the Bald Hills grasslands over thousands of years (Popenoe et al. 1992). Before the arrival of Euro-Americans around 1850, American Indians traditionally used fire to increase the amount of acorns and seeds, basket making materials, and forage for deer and elk. Euro-Americans brought livestock and nonnative pasture plants and built roads. These disturbances along with the cessation of burning created wholesale changes to the ecosystem, including the unchecked establishment of woody species in the Bald Hills. Douglas-fir, held in check for millennia by frequent fire and low intensity anthropogenic impact, was able to establish in increasing numbers under a regime of high intensity anthropogenic impact and lack of fire. Douglas-fir has taken over large areas of prairie and oak woodland since the settlement period. RNSP staff instituted a program of prescribed fires (planned ignitions) and cutting to remove encroaching Douglas-fir and restore fire as an ecosystem process.

Values to be protected include
1)Historic structures
2)Cultural landscapes
3)Native grasses and oak woodlands and plant species diversity

Management considerations include:
1)Cultural resources, particularly historic structures
2)Prescribed fire planning – spatial and frequency distribution
3)Invasive plant species
4)Migratory bird nesting habitat
5)Safety on Bald Hills Road corridor

**Response to Wildland Fire**

Fires within this FMU may be managed for resource benefit.

**Preparedness activities in the FMU will include the following projects:**

**Annual Fuels Reduction around Historic Structures**

An annual maintenance schedule will be set up in the Fire Management Program to reduce the hazard fuels around historic structures within the Bald Hills FMU. Mowers, weedeaters and hand tools will be used to cut grass and other vegetation around the structures after grass has cured (June-July), and work will be limited to within a 40 foot radius of the structure. Handline up to four feet wide will be constructed down to mineral soil. Handline will be built using hand tools and located just outside of the roof drip line.

All wildlife restrictions regarding the use power tools will be adhered to.

The historic structures to be protected include:

Elk Camp Barn: 9.7 miles up Bald Hills Road.

Dolason Barn: 11.5 miles up Bald Hills Road to Dolason Prairie Trailhead, 2 miles to barn from trailhead.

Lyons Ranch Barn and Bunkhouse: 17 miles up Bald Hills Road to Lyons Ranch Trailhead, 2 miles to barn and bunkhouse from trailhead.

Dooleyville Line Shack: 17 miles up Bald Hills Road to Lyons Ranch Trailhead, 1.8 miles down Lyons Ranch Trail (road), .7 miles down slope of trail.

Long Ridge Sheep Shed: 17 miles up Bald Hills Road to Long Ridge Road, 1 mile on Long Ridge Road to barn.

Coyote Creek Barn: 17 miles up Bald Hills Road to Long Ridge Road, 1 mile on Long Ridge Road to Ranch Road, 1.3 miles East on Ranch Road to Barn.

Coyote Creek Cabin: 18.75 miles up Bald Hills Road to Rock Fork Road, 1 mile down Rock Fork Road to Cabin.

**Water Source Development and Improvement**

Sources of water for suppression support are limited within the Bald Hills FMU. Several strategies were evaluated in an effort to deal with the shortage of water within the FMU. Two strategies were determined to be the most effective at providing accessible adequate water supplies while minimizing ground disturbance and the effects on wildlife and fisheries.

***Pond Access Improvement and Maintenance:***

Three ponds were determined to be of strategic importance to suppression efforts within the FMU. Many of these ponds have become overgrown with brush and are no longer readily available for use. All work on the three ponds will be done with chainsaws and handtools. A chipper may be used to dispose of branch wood where appropriate. All saw cuts will be flush to the ground. Any site requiring the disposal of debris through pile burning will follow all protocols outlined in a debris pile burn plan. All burn sites will be rehabilitated with cut vegetation or leaf litter obtained locally. All wildlife restrictions regarding the use of power tools will apply.

Ponds within this FMU include:

**Upper Elk Camp Pond:** Located at milepost 9.7 on Bald Hills Road, below the ranger residence. This pond is of strategic importance as a water source because it can be made accessible to portable pumps to fill engines and waters tenders. Access has become increasingly difficult due to uncontrolled growth of live vegetation around the pond. Removal of selected trees and shrubs up to 12 inches in diameter from pond edge and out 30 feet will allow unrestricted use for pump operations. Debris will be disposed of by pile burning. The project area is 1 acre.

**Lower Elk Camp Pond:** Located at milepost 9.7 on Bald Hills Road, 500 ft below the upper pond. This pond would be a good water source for portable pump operations. Dense Douglas-fir has encroached along the earthen dam. These trees will eventually compromise the dam's ability to hold water either because the roots will weaken the dam or because the trees are susceptible to windfall. The removal of 20 trees up to 12 inches in diameter along earth dam will maintain the dam's integrity. Debris will be disposed of by pile burning. The project area is ½ acre.

**Coyote Pond:** Located up Bald Hills Road, at milepost 18.75 to Rock Fork Road at milepost 1. This pond is critical to the prescribed fire and wildland fire suppression programs. It provides easy access for fire engines and water tenders. Removal of down debris within the pond will improve access for drafting. Debris will removed by hand or winch, cut into manageable lengths and scattered in the surrounding forest. The project area is ½ acre.

**Water Storage Development**

A polyplastic 2,500-gallon tank will be placed within the FMU to provide water for filling fire engines and/or water tenders during fire suppression activities. Tank site preparation will require leveling an area 10 feet in diameter and where appropriate, applying a 2 inch base of crushed rock. If crushed rock were not an option for a particular site a platform made from milled redwood would be built to hold tank. The redwood platform would be no more than two feet tall and built to conform to appropriate engineering specifications. Tanks will be placed adjacent to roads as to not interfere with normal road maintenance.

The tank will be self-filling from stream water using a 2-3 inch PVC pipe that will be placed in the stream channel above tank to allow for gravity filling. Some rocks within the stream channel may need to be moved to secure the inlet pipe and maximize flow to tank. A shutoff valve installed in the waterline near the tank will regulate the flow of water into the tank. If needed, an overflow pipe will be installed in the top of tank to direct water back into stream channel. A collection system will be built around the top of the tank. All wildlife restrictions regarding the use power tools will be adhered to during construction and setup.

**Water Tank sites for this FMU include:**

Ranch Road and stream filled.

**Road Improvement**

Several roads have been identified by an interdisciplinary team as being critical to the RNSP Fire Management Program. These roads serve as access to remote fire prone areas, historic structures, and water sources or act as prescribed fire unit boundaries.

The following roads identified within this FMU may require additional maintenance to bring the road up to standards allowing for:

1) Access for Type 3 engines.
2) Wet weather access.
3)Serve as a burn unit boundary with adequate holding attributes.

**Prescribed Fire**

Ethnographic research and historic records indicate that American Indians routinely burned the prairies in the Bald Hills in the fall. Fire was reintroduced into the Bald Hills by NPS resource managers to maintain plant species diversity. Fire has recently been used to maintain significant cultural landscapes and plant materials associated with traditional cultural practices.

**Mechanical Fuels Reduction**

There are no mechanical fuels reduction treatments proposed for this plan within this FMU.

**Wildland-urban Interface (WUI) FMU**

The WUI FMU includes all of the areas within RNSP that border or where a wildfire could affect Communities at Risk as defined by the National Fire Plan. WUIs in California identified in the Federal Register (Vol. 66. No. 160, Friday, August 17, 2001, pages 43387-43390) and located immediately adjacent to parklands include Orick, Berry Glen, Klamath, Hiouchi, and Douglas Park. Douglas Park is located along Douglas Park Road, which becomes Howland Hill Road when it enters Jedediah Smith Redwoods State Park.

Values to be protected include:

- Human health and safety
- Personal property
- Park developments

Management considerations include:

- Threatened and endangered species habitat
- Adjacent vegetation types
- Invasive plant species
- Visual quality
- Highway safety

- Smoke

**Response to Wildland Fire**

A full suppression policy will be implemented within the WUI FMU with a target of controlling 95% (or better) of all unwanted fires during initial attack, in accordance with NPS policy.

**Prescribed Fire**

There is one prescribed fire treatment proposed within this FMU for this plan. The only other direct application of fire will be burning of slash piles created during the mechanical fuel reduction projects.

***Davison:*** A low intensity prescribed burn would be conducted in a ten acre unit bounded by Prairie Creek, Davison Road, the bike path, and a small handline from the bike path back to Prairie Creek (see attached map). We would avoid burning in any areas with developments. Preparation for burning may affect a 50foot wide strip alongside the bike path, which would likely include piling and burning of woody debris. This project will not burn any vegetation on the southeast side of Prairie Creek. The objective of this project is to determine the presence of *Iliamna latibracteata*, a rare plant with fire-stimulated germination. This plant has been discovered growing in burned areas where none had been noted prior to burning. HSU has voucher specimens of this plant collected adjacent to the Davison Ranch.

**Mechanical Fuel Reduction**

***Wolf Creek Structures Shaded Fuel Break (SFB):*** The project will reduce fuel loadings and ladder fuels 50-100 feet around the structures in the Wolf Creek area, including the Wolf Creek School, Wolf Creek Housing, and the Wolf Creek Fire Cache. The target fuels include live and dead branches within 7 feet of the ground, suppressed trees less than 18" DBH, brush, and surface fuels less than18"in diameter. There will be very little impact to the overall canopy cover in the treated area as the majority of the target fuels are in the understory.

***Wolf Creek Road Shaded Fuel Break:*** The Wolf Creek SFB was created in 2006 to reduce the chance of fire spreading between the Wolf Creek area of the national park and the residences along US Highway 101 from the southern end of the US Highway 101 park bypass to the private residence at Berry Glen. It will be maintained as needed for the life of this plan.

***Hiouchi Fuel Break maintenance:*** The Hiouchi Fuel Break was created in 2002-2003 to reduce the chance of fire spreading between the community of Hiouchi and RNSP. This fuel break will be maintained as needed for the life of this plan.

**State Parks FMU**

Fire management in the three state parks is the responsibility of the California Department of Forestry and Fire Protection (CalFire). Preparation and pre-planning for wildfires will continue, with CDF taking the lead on fuels reduction where needed to protect lives and property. All wildfires will be aggressively suppressed. The NPS will continue to take part in planning and implementing prescribed fires in Boyes Prairie in Prairie Creek Redwoods State Park.

Values to be protected:

- Old growth trees
- Historic structures
- Visual quality

Management considerations include:

- CDF policies
- Safety in highway corridors.
- Campgrounds
- State wilderness areas
- Interagency cooperation
- Invasive plant species

**Response to Wildland Fire**

A full suppression policy will be implemented within the State Parks FMU with a target of controlling 90% (or better) of all unwanted fires during initial attack, in accordance with CDF Policy.

**Prescribed Fire**

***Boyes Prairie*:** Boyes Prairie in Prairie Creek Redwoods State Park has been burned several times as part of the RNSP fire program. Prescribed fires at Boyes Prairie are planned and implemented as a collaborative effort among the national park fire program and vegetation management staff, the state park resource management staff from the Eureka North Coast District Office and the RNSP resource ecologist, and CDF. It is the only prescribed burn unit within the three state parks included within RNSP. The unit size is 123 acres.

### Mechanical Fuels Reduction

There are no mechanical fuels reduction treatments proposed for this plan within this FMU.

## FIRE MANAGEMENT PLANNING

This section outlines RNSP's goals during wildfire management and fuels reduction activities in the park as described in the Fire Management Plan (NPS 2004a). The FMP Environmental Assessment states that fire management in RNSP includes all activities undertaken to prevent, control, suppress, and utilize fire for the protection of human safety, personal property, and irreplaceable natural and cultural resources. Fire management activities in the park includes suppression of wildfire, prescribed fire, mechanical fuel reduction, fire effects monitoring, and fire operations planning. The following section is taken largely verbatim from the Fire Management Plan (NPS 2004a:12–13).

### Wildfire Management

Wildfires can have devastating adverse effects on cultural resources. Wildfires tend to burn at moderate to severe temperatures. In accordance with Reference Manual-18 (RM-18) (NPS 2004a:51), wildland fires will be suppressed in a prompt, safe, aggressive, and a cost-effective manner to produce a fast, efficient action with minimum damage to resources. All wildland fires within RNSP are suppressed. The suppression of a wildland fire involves a range of possible actions from initial attack to final suppression, including preparedness activities. The goals for RNSP Fire Management Program include:

- *Ensure safety to the fire fighter and public is the highest priority in every fire management action.*
- *Protect the public, private property, and the natural and cultural resources of the park utilizing strategies and tactics commensurate with values at risk.*
- *Use fire as a management tool to meet resource objectives where deemed appropriate and indentified risk is both manageable and acceptable.*
- *Manage wildland fuel complexes in order to protect resources at risk and minimize unacceptable impacts from fire.*
- *Cooperate with adjacent landowners and land management agencies in the full range of fire management activities, respecting the jurisdiction, interest, and legal mandates of each participant.*
- *Increase the understanding of the role and function of fire in the parks.*
- *Restore fire as an ecosystem process in the park's biotic communities to the fullest extent practical. (NPS 2004a:12).*

Wildfire suppression actions in the national park will be conducted using Minimum Impact Suppression Tactics (MIST) to minimize adverse effects to resources and avoid irreversible damage once the fire emergency is over. MIST actions specific to RNSP are directed at protecting the significant resources that are unique to the parks. Old growth redwood trees are the most important of these resources and will be protected in two ways from wildfires. If a ground fire enters old growth forest, a fireline will be constructed around the base of trees, and litter and other dense fuels will be removed. If an individual tree is on fire, the tree will not be cut unless there is a significant risk to human safety or property. The tree will be monitored in case the fire spreads to other nearby trees or threatens to ignite a larger area. If the fire threatens to spread to adjacent trees, fire managers will attempt to have aircraft perform bucket drops on the individual tree. Cutting a large tree will be the last resort in a fire emergency.

Other MIST actions will have short-term localized adverse effects on vegetation and soils, but the tactics will have fewer adverse effects than aggressive suppression techniques intended to suppress the fire in the least amount of time within the smallest perimeter possible. MIST are developed for the specific resources of the park and are implemented in a manner intended to reduce the short and long term adverse effects of suppression.

**Fuels Management**

Fuels management is an important component of wildfire management. The twentieth century fire management prevention/suppression programs, along with decades of timber harvesting have resulted in the problematic buildup of underbrush and dead vegetation that fuel moderate to severe wildfires destroying natural resources, cultural resources, human life and property (Jackson 1998:1).

### *Prescribed Burning*

Prescribed burning is a component of a fuels management plan. Fires are carefully planned and ignited by fire personnel under controlled conditions. A prescribed fire program requires: the selection and prioritization of prescribed burns to be carried out during the year; creating prescribed burn plans; the development of burn prescriptions, burn operations, documentation and reporting; and the creation of burn critiques. According to Jackson (1998:1), the careful application of prescribed fires can be beneficial to cultural resources. They reduce the buildup of dangerous fuel loads which can result in higher severity wildfires that can damage or destroy cultural resources either directly or as a result of wildfire suppression. Prescribed fires can dramatically improve ground visibility by the reduction of vegetation and ground cover on the surface, allowing for the discovery of previously unknown cultural resources.

### *Mechanical Thinning*

Mechanical fuels treatment is the application of various tools and equipment to reduce fuels and achieve fire and resource management goals. Specifically, the mechanical treatments allow for the reduction of fuels, restore the historic composition and structure to plant communities, reduce the risks associated with large-scale, highly destructive fire events, and allow for the construction of shaded fuel breaks or fire control lines (NPS 2004a:56).

Mechanical thinning is usually accomplished by work crews with hand tools such as chainsaws and weed-eaters and reduces the surface vegetation and ladder fuels (e.g., low hanging limbs). Cut materials are then placed into piles and burned in the winter or ground into chips by mechanical wood shredders.

The next chapter is the compliance section for the protection of cultural resources at RNSP. It outlines key protective measures and guidelines to follow during prescribed burns, fuel thinning, and wildfires. The chapter also includes a discussion on post-wildfire burned area protection. The chapter ends with future research suggestions which are needed to gain a better understanding of the effects of fire and fire mangement and cultural resources.

# CHAPTER 6. INTEGRATING TREATMENTS FOR CULTURAL RESOURCES INTO FIRE MANAGEMENT PLANS

The following chapter describes how treatments and other protective measures for cultural resources are integrated into fire management at RNSP. As discussed in previous sections, a FMP's goals are to protect the public, private property, and the natural and cultural resources of the park utilizing strategies and tactics commensurate with the values at risk. Nearly all fire management projects qualify as undertakings for the purposes of Section 106 of the NHPA. An undertaking is defined as

> Any project, activity, or program that can result in changes in the character or use of historic properties, if any such properties are located in the area of potential effects. The project, activity, or program must be under the direct or indirect jurisdiction of a Federal agency or licensed or assisted by a Federal agency. [36 CFR 800.2]

The NPS intends to comply with Section 106 NHPA for fire management activities at RNSP by following the process outlined in 36CFR800 until such time that a Programmatic Agreement can be developed that will help to streamline the Section 106 NHPA process for fire management activities in consultation with the California SHPO, affiliated tribes, the public, and the Advisory Council on Historic Preservation and as authorized by 36CFR800.14.

Protective measures for cultural resources during prescribed burns and wildfire events are similar in nature. Siefkin (2001:n.p.) defines two categories of protective measures for cultural resources:

- Exclusionary tactics involve preventing fire from burning on or in close proximity to a cultural resource through the use of some predetermined fire management action such as a fire line, sprinkler system, or intentionally burning out the perimeter of a resource. Exclusionary tactics are often employed when it is anticipated, given expected fire behavior, that the fire will burn at an intensity that exceeds the threshold above which a particular resource or resource attribute is impacted (e.g., ~100° C for obsidian hydration rinds). Other examples of exclusionary techniques that have been employed with success include fire shelters, fire retardants, hand and mechanical fuel removal, and fuel burial.

- Non-exclusionary tactics make no attempt to exclude fire from a resource of interest, but instead seek to produce fire intensities below that expected to cause resource damage and/or that will not lead to future indirect effects. Common non-exclusionary approaches to resource protection include hand and mechanical fuel load reduction, burning under favorable prescriptions, and removal of vulnerable resources.

## CULTURAL RESOURCE COMPLIANCE FOR FUELS MANAGEMENT PLANNING

### Pre-project Work

The 2004 RNSP Environmental Assessment presents the following guidelines for fuel management planning.

#### Guidelines for Cultural Resource Protection during Operational Actions

- Consult with the affiliated Tribes, cultural resource advisors at the NPS Regional Office, and the SHPO/THPO.
- Identify cultural resources within the area of potential impact for the undertaking.
- Assess potential for adverse effects to cultural resources.
- Complete assessments of hazardous fuels when cultural resources are present.
- Develop appropriate management recommendations to mitigate adverse effects to cultural resources in consultation with affiliated Tribes, cultural resource advisors at the NPS Regional Office, and the SHPO/THPO.

General strategies currently employed for cultural resource protection include:

- Plan and implement prescribed burns to take advantage of environmental conditions that minimize impacts to cultural resources.
- Avoid cultural resources during fire program operational activities Exclude fire from cultural resources.
- Minimize the impact of fire through fuel load reduction around cultural resources.
- Conduct preventative maintenance consisting of hazard fuel reduction at or around cultural resources.
- Employ environmentally friendly, minimum impact rehabilitation/suppression techniques (MIST) in the vicinity of cultural resources.
- Monitor archeological sites.
- Conduct research regarding the role of fire as used by American Indians in lands now within RNSP. (NPS 2004b:94).

**Identifying and Recording Cultural Resources**

Fire managers plan and use fire behavior predictive models to supply the cultural resource manager with an Area of Potential Effects (APE). Then the cultural resource manager devises a strategy to protect resources and minimize impacts from fire and fire suppression.

A pre-burn survey of the APE is necessary if an inventory has not been conducted previously. The survey methods would depend on the location, terrain, and expected resource types but in most cases would involve pedestrian survey. Recording new cultural resources or updates to previously recorded resources should be recorded on the appropriate forms and should include sketch maps and GPS information.

The cultural resource manager conducts background research to investigate the kinds of cultural resources known or suspected to occur within a given burn unit(s) (Jackson 1997:12–13 as cited in Siefkin 2001: n.p.). These are referred to as *resources of interest*, and include classes that that may be eligible to NRHP and also may be affected by direct, operational, or indirect fire efforts. In addition to historic properties, there may be other resources in the APE which may not meet the NRHP threshold, but nevertheless have values that may which be compromised by fire or fire management (Siefkin 2001: n.p.). It is important to consult with the local tribal representative and any other concerned Native American groups to address their concerns have and to help identify traditional cultural properties and ethnographic resources in the APE.

**Evaluation and Determination of Effect**

Careful thought and planning are needed to determine the project's effects on cultural resources. From the inventory cultural resource managers can determine what types of cultural resources are located within the APE. This will allow them to assess effects and appropriate treatment measures. As described above, effects may be direct, operational, or indirect. Appendix C, the impact matrix, will help determine the effect of a specific effect type on the various resource types. The cultural resource manager must know the attributes of each cultural resource contains (e.g., obsidian flakes, wood lumber, or an earthen ditch). Once the attributes are known, appropriate protection measures can be put in place.

## Protection, Treatment, and Monitoring

### *Mechanical Thinning*

Mechanically thinning trees and vegetation within a historic property is allowed. However the park's Programmatic Agreement states that the methods employed must not disturb the ground surface and that the vegetation which is to be removed must not contribute to the significance of that property (NPS 2008:16). The resulting slash must be removed and disposed of in a location where there are no cultural resources.

### *Prescribed Fire*

Protection for cultural resources during a prescribed fire depends on the characteristics of the historic properties involved. Avoidance is a short term solution to protect the resource. Under the Park's Finding of No Significant Impact (FONSI) agreement, fuels must be reduced in the vicinity of historic buildings/structures and fire lines and 40-foot-wide defensible spaces created. Archaeological sites that may be affected by the construction of fire lines will be protected by having archeologists inventory areas of proposed construction prior to ground disturbance and mark the resources on the ground (NPS 2005:4). Non-built environment resources are protected from the adverse effect of the fire by initially determining the proposed fire intensity. If the fire intensity is to be greater than the resource attributes threshold of damage, then the property must be protected. The FONSI states that if adverse effects on cultural resources are anticipated the SHPO or THPO must be consulted (NPS 2005:3).

Jackson (2004:42–46) suggests the following treatments to mitigate the effects of prescribed fires:

- **Redesign.** Fuel management projects may be redesigned to exclude the area containing and surrounding cultural resources.

- **Buffer Zones.** Buffer zones can be created around cultural resources to lessen the chance of adverse effects from fire.
- **Firebreaks.** Cultural resources may be protected by fire crews constructing firebreaks (firelines) which eliminate and break the chain of fuels to that resource. The types of firebreaks include natural firelines, retardant lines, wet lines, handlines, scratch lines, and catlines.
- **Sprinklers.** Sprinklers can be used as a preventative measure.
- **Foam wetting agents (suppressants) and fire retardants.** Foams may be applied to cultural resources and/or around cultural resources to protect them from damage.
- **Back burning.** Back burning may be used to reduce fuels, which adds a buffer zone between the cultural resource and the fire.
- **Fire Fabric or Wraps.** Fire resistant may be placed over combustible resources to protect them from burning. Sometimes known as "cabin wrap," the metallic material is stapled around the perimeter to form a nonflammable barrier.
- **Burial.** The heat effects of fire on cultural resources are far less severe when buried at least 10cm below the surface. This type of protective measure is commonly used on well-defined features such as outcrops where the soil can be removed without damaging the resource.

### *Monitoring*

According to the FMP FONSI (NPS 2005:4), an archaeological monitor should be present during a prescribed burn in order to help prevent adverse effect to cultural resources. The monitor can advise park personnel on the cultural resources in the APE.

## Reporting

RNSP conducts post-burn site assessments of historic properties to determine if cultural materials were adversely affected by a fire event or fuel management project, or if they are threatened by long-term indirect impacts such as erosion. The assessment analyzes data about the event and its effects to determine if mitigation measures should be modified. Jackson (1998:21) suggests that a post-fire survey of the APE could be beneficial for locating previously unrecorded resources and would advance RNSP's compliance with Section 110(a)(2) of NHPA.

## CULTURAL RESOURCE COMPLIANCE FOR WILDFIRE MANAGEMENT

Wildfires present a challenge for the resource manager due to the rate of growth, intensity, and other uncontrollable fire variables. No organization, technology, or equipment can provide absolute protection when unusual fuel loads, extreme weather conditions, multiple ignitions, and extreme fire behavior come together to form a catastrophic event. The safety of firefighters and public is highest priority during these events (NPS 2004a:12).

### Pre-project Work

As wildfires and emergency fire-suppression efforts generally preclude the usual careful environmental review or cultural resource inventory a database with containing all known cultural resources within each FMU, along with maps, is part of RNSP's guidelines for actions during a wildfire event (see guidelines below).The cultural resource manager's job at the beginning stage of planning is to come up with a strategy of how to protect and minimize the unacceptable impacts from fire and fire suppression activities. It is important to consult with the local tribal representative and any other concerned Native American groups to address their concerns have and to help identify traditional cultural properties and ethnographic resources in the APE.

The fire managers use fire behavior predictive models and need to supply the cultural resource manager with an APE. Below are guidelines for the protection of cultural resources (NPS 2004b:20).

**Guidelines for Cultural Resource Protection during Wildfire Events**

- Maintain and make available cultural resource digital databases and GIS layers on CDs or other portable digital format during fire season in order to expedite the management decision making process.
- Notify immediately the park cultural resources program manager and/or Northern California Sub-cluster fire archeologist, or other NPS cultural resource advisor in the event of wildfire that requires extended attack.
- Ensure consultation with an archeologist and/or other cultural resource specialist and notify SHPO/THPO if extended attack is employed and the wildfire is in an archeologically or culturally sensitive area.
- Consult with affiliated tribes when resources of ethnographic significance are threatened by fire or fire suppression activities.
- Ensure that historic structures, cultural landscapes, archeological sites, and resources of ethnographic significance that are determined eligible or listed on the NRHP are a priority in resource protection planning. (RNSP Environmental Assessment 2004:94)

**Evaluation and Determination of Effects**

**Wildfire**

The cultural resource manager must prioritize which cultural resources are at risk and what the effects to those resources may be (NPS 2004b:94). During a wildfire event, temperatures can be extreme and fire severity classes are in the moderate to high range. Given these temperature, most cultural resources will be adversely affected by the fire. Additionally, operational impacts from fire management activities have a much greater chance of adversely impacting cultural resources.

**Post Wildfire**

The extent of damage must be determined after a large wildfire so that effective mitigation can be prescribed to protect the cultural resources. RNSP conducts post-burn site assessments of historic properties to determine if and how cultural resources were adversely affected by preparation for or during a fire event, or if they are threatened by long-term indirect impacts such as erosion. The assessment analyses the data to determine if mitigation measures should be modified.

The Burned Area Emergency Response (BAER) program and the Burned Area Rehabilitation (BAR) programs were developed to respond to, evaluate, and mitigate indirect effects from wildfires. The BAER determines the need for treatment to minimize threats to life or property and prevent unacceptable degradation to natural and cultural resources resulting from the effects of a fire. It also prescribes and implements treatments. A BEAR team evaluates each resource on a standard form to determine the fire's effects. This task must be completed within one year from the date of wildfire containment (NPS 2006b:6).

The BAR program evaluates actual and potential long-term, post-fire, impacts to critical cultural and natural resources, and identifies areas that are unlikely to recover naturally from severe wildfire damage. A program goal is to develop and implements plans to emulate historical or pre-fire ecosystem structure, function, diversity, and dynamics consistent with approved land management plans. If that is not feasible, then a plan is created to restore a healthy, stable ecosystem in which native species are well represented (NPS 2006a:6).

## Protection, Treatment, and Monitoring

### *Wildfire Protection*

During a fire, the cultural resource manager should be in close contact with fire managers to identify the cultural resources at risk. No organization, technology, or equipment can provide absolute protection of cultural resources from the fire. Avoidance is the best protection measure for cultural resources. As discussed above, a variety of protective measures are available to prevent adverse effects on cultural resources. Below are protective measures presented by Jackson (2004:42–46), however due to the uncontrollable nature of a wildfire, these measures may be more restrictive than for use in a prescribed fire.

- **Buffer zones.** Buffer zones can be cleared around cultural resources to lessen the chance of adverse effects from fire or fire management.
- **Firebreaks.** Cultural resources may be protected firebreaks (firelines) that eliminate and break the chain of fuels to the resource. Types of firebreaks include natural firelines, retardant lines, wet lines, handlines, scratch lines, and catlines.
- **Sprinklers.** Sprinklers can be used to prevent the progress of fire.
- **Foam wetting agents (suppressants) and fire retardants.** Foams may be applied to cultural resources and/or around cultural resources to protect them from fire damage.
- **Back burning.** Back burning reduces fuels, which adds a buffer zone between the cultural resource and the fire.
- **Fire fabric or wraps.** Fire resistant fabric may be placed over combustible resources to protect them from heat. Sometimes known as

*cabin wrap*, this metallic material is stapled around the perimeter to form a nonflammable barrier.

- **Burial.** The effects of heat on many archeological resources is far less severe when the resource is buried at least 10cm below the surface. This type of protective measure is commonly used on well-defined features such as rock outcrops where the soil can be relocated without damaging the resource.

### *Post Wildfire*

The protection and stabilization of cultural resources affected by fire and fire management activities fall under the policies of both BAER (short term emergency stabilization) and BAR (long term stabilization and rehabilitation).

**BAER Treatments.** BAER's comprehensive manual describes recommended treatments (NPS 2006c). The objectives of these treatments is to stabilize and prevent degradation to archeological sites, cultural landscapes, traditional cultural properties, and historic structures until long-term cultural resource management strategies can be developed and implemented. BAER is design to conform to the NHPA Section 106 Process (36CFR800). Below is a description of allowable and prohibited actions under the BAER program (NPS 2006b:11–12).

*Allowable Actions*

- Site Stabilization and Protection. Determining whether known historic properties may be further degraded (e.g., through the creation of a site inspection record). Incidental discovery of cultural resource sites should be noted; these may be protected.

- Patrolling, camouflaging, or burying significant heritage sites are appropriate actions when necessary to prevent a critical loss of heritage site value when looting potential is high. Patrolling should be considered only where there are not other effective alternatives.

- NHPA Section 106 Compliance. Emergency stabilization treatments that disturb the soil surface are reviewed for potential effects on significant cultural resources. The appropriate agency cultural resource specialist should become involved in treatment planning as early as possible.

- Treatments evaluated as No Historic Property (36 CFR 800) (no historic properties present), or as actions permitted under existing agency programmatic agreements or memorandum of agreement can be undertaken without further State Historic Preservation Officer or Tribal Historic Preservation Officer consultation. Treatments with no adverse effect can be undertaken after appropriate consultation with SHPO or THPO. Treatments with adverse effect should be addressed by the agency cultural resource coordinator.

*Prohibited Actions*

- Systematic inventories or surveys.
- Assessments of the cultural resource damage caused by the fire.
- Site and data recovery, cataloging, and other programmatic administrative actions.
- Heritage site restoration.
- Wildfire suppression activity damage repair.

**BAR Treatments.** According to the BAR Guidebook (NPS 2006a:12–13), burned area rehabilitation treatments that disturb the soil surface must be reviewed for potential effects on cultural resources. The cultural resource specialist should become involved in treatment planning as early as possible.

Treatments evaluated as No Historic Property (no historic properties present) or as actions permitted under existing agency programmatic agreements or memorandum of agreement can be undertaken without further State Historic Preservation Officer or Tribal Historic Preservation Officer consultation. Treatments with no adverse effect can be undertaken after appropriate consultation with SHPO or THPO. Treatments with adverse effect should be addressed by the agency cultural resource coordinator.

**Prohibited Actions**

- BAR funds cannot be used for restoration of any cultural resource or heritage site.

***Post Fire Surveys.*** Jackson (1998:21) notes that post-fire surveys should be employed in the burned area: to provide inventories of lands previously inaccessible due to dense brush and vegetation; monitor the effectiveness of pre-fire archaeological survey(s); to increase heritage resources inventories for the RNSP, providing more comprehensive management and research information, and to advance RNSP's compliance with the requirements of Section 110(a)(2).

***Monitoring.*** Monitoring will take place under both BAER and BAR programs. Monitoring is important to the long term protection of the cultural resource because it documents changing conditions, which can be corrected.

## Reporting

RNSP conducts post-burn site assessments of historic properties to determine if cultural materials were adversely affected by fire event or fuel management project, or if they are threatened by long-term indirect impacts such as erosion. The assessment analyzes data about the event and its effects to determine if mitigation measures should be modified. A post-burn survey of the burned area is suggested by Jackson (1998:21). A post-fire survey of the APE would be effective for locating previously unrecorded resources and would advance RNSP's compliance with Section 110(a)(2) of NHPA.

Yosemite National Park creates an annual report that describes the effects on cultural resources. The report includes survey coverage, inventory forms, pre-burn and post-burn condition evaluation forms, a description of protection and treatment measures, and recommendations for future monitoring (NPS 2007). Instituting this kind of report would be an effective way to document the effects of fire at RNSP.

## FUTURE RESEARCH NEEDS AND OPPORTUNITIES

The following research needs have been identified while developing this document.

- Evaluate the effectiveness of both pre-burn and post-burn surveys. In areas of dense vegetation, surface visibility can be quite low. It would be beneficial to identify the frequency with which cultural resources have been missed in pre-burn survey by comparing the results with post-burn survey.
- Evaluate the effectiveness of current site protection measures after a wildfire event by regular monitoring.
- Carry out more research on the effect of fire on cultural materials. Many studies have been carried out in controlled laboratory settings that show the temperatures at which material (e.g., obsidian) is affected. Future studies should look at the effects of lower temperatures and longer exposures on these materials.
- Document the use of fire in restoring and maintaining cultural landscapes and natural resources. Underwood et al. (2003) note that the Bald Hills area of RNSP was altered by Native Americans who employed fire to maintain corridors in order to improve resource reliability. Fire was also used in Bald Hills during the historic period.

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# Appendix

Table 7.

**Cultural Resources at Risk from Grass Fires. Effects Identification Matrix. Redwood National Park.**

| HISTORIC CONTEXT | RESOURCE TYPE | ELEMENT | Impact Potential | Potential Impact | Treatments |
|---|---|---|---|---|---|
| (Effects based on peak surface temperatures of 225°C during grass fires from Duke et a. 2003:22) | | | | | |
| **Prehistoric** | Habitation site/ camps | Midden | | Low | |
| | | Obsidian | Possible loss of hydration rim | High | AC, FR, R, BZ, FB, SR, BB, M |
| | | Basalt | | Low | |
| | | Chert | Possible fracturing and color change | High | AC, FR, R, BZ, FB, SR, BB, M |
| | | Shell | | Low | |
| | | Faunal bone | | Low | |
| | | Groundstone | | Low | |
| | | Human remains | | Low | |
| | | Bedrock mortar | | Low | |
| | | Wooden feature | Burning | High | FR, R, BZ, FB, S, *SR, BB, FF, M |
| | Trail | Earth | | Low | |
| | Lithic scatter | Obsidian | Possible loss of hydration rim | High | FR, R, BZ, FB, SR, BB, M |
| | | Basalt | | Low | |
| | | Chert | | High | FR, R, BZ, FB, SR, BB, M |
| | Chert quarry | Chert | Possible fracturing and color change | Low | |
| **Ranching** | Building | Wood | Burning | High | FR, R, BZ, FB, S, *SR, BB, FF, M |
| | | Glass | | Low | |
| | | Steel (carbon) | | Low | |
| | | Iron | | Low | |
| | | Brick | | Low | |
| | | Stone/cement | | Low | |
| | | Foundation | | Low | |
| | Wooden fence | Wood | Burning | High | FR, R, BZ, FB, S, *SR, BB, FF, M |

| HISTORIC CONTEXT | RESOURCE TYPE | ELEMENT | Impact Potential | Potential Impact | Treatments |
|---|---|---|---|---|---|
| | | Iron nail | | Low | |
| | Utility pole | Wood | Burning | High | FR, R, BZ, FB, S, *SR, BB, FF, M |
| | Orchard/ fruit tree | Wood | Burning | High | FR, R, BZ, FB, S, *SR, BB, M |
| | Cement cistern | Cement | | Low | |
| | Cement water trough | Cement | | Low | |
| | Embankment | Earth | | Low | |
| **Ranching (con't)** | Lyons gravestone | | | Low | |
| | Historic-era artifact concentration | Glass | | Low | |
| | | Solder (tin alloy) | Melting | High | FR, R, BZ, FB, S, *SR, BB, M |
| | | Tin | | Low | |
| | | Lead | | Low | |
| | | White pot metal | | Low | |
| | | Zinc | | Low | |
| | | Aluminum | | Low | |
| | | Brass | | Low | |
| | | Silver | | Low | |
| | | Copper | | Low | |
| | | Cast Iron | | Low | |
| | | Steel (stainless) | | Low | |
| | | Porcelain | | Low | |
| | | Iron | | Low | |
| | | Wood | Burning | High | FR, R, BZ, FB, S, *SR, BB, M |
| | Stock pond | Earth | | Low | |
| **Military** | Building | Concrete | | Low | |
| | | Aluminum | | Low | |

| | | | | | |
|---|---|---|---|---|---|
| | | Steel (carbon) | | Low | |
| | | Iron | | Low | |
| | | Wood | Burning | High | FR, R, BZ, FB, S, *SR, BB, FF, M |
| | | Cinderblock | | Low | |
| **Logging and Mining** | Skid road | Earth | | Low | |
| | R.R. grade | Earth | | Low | |
| | R.R. track | Iron | | Low | |
| | | Steel (carbon) | | Low | |
| | R.R. sleeper | Wood | Burning | High | FR, R, BZ, FB, S, *SR, BB, FF, M |
| | Logging equipment | Steel (carbon) | | Low | |
| | | Iron | | Low | |
| **HISTORIC CONTEXT** | **RESOURCE TYPE** | **ELEMENT** | **Impact Potential** | **Potential Impact** | **Treatments** |
| **Logging and Mining (con't)** | Bridge | Wood | Burning | High | FR, R, BZ, FB, S, *SR, BB, FF, M |
| | Tailings/mine waste | Stone | | Low | |
| | Ditch | Earth | | Low | |
| | Adit | Earth | | Low | |
| **Ethnographic / Traditional Resources** | Basketry and food | Vegetation | Burning/Native American concerns | High | FR, R, BZ, FB, SR, BB, C, M |
| | Goose pen (hollow tree) | Wood | Burning/Native American concerns | High | FR, R, BZ, FB, SR, BB, C, M |
| | Ceremonial/spiritual | Landscape | Burning/Native American concerns | High | FR, R, BZ, FB, SR, BB, C, M |

***SR**= Chemical suppressants/retardants should only be used in case of an emergency. These chemicals could cause adverse effects to historic-era wooden structures and metal equipment.

**Note:** While treatments vary by material type, it is important to consider all the elements for each given resource.

**KEY**

**Low** = No or minor impact is likely

**High** = Impact is likely

**AC** = Artifact collection

**FR** = Fuel reduction/mechanical thinning

**R** = Redesign

**BZ** = Buffer zone

**FB** = Fire break

**S** = Sprinkler

**SR** = Suppressant and fire retardant

**BB** = Back burning

**FF** = Fire fabric/wrap

**B** = Burial

**C** = Consultation

**M** = Monitoring

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**Table 8.**

## Cultural Resources at Risk from Brush Fires. Effects Identification Matrix. Redwood National Park.

| HISTORIC CONTEXT | RESOURCE TYPE | ELEMENT | Impact Potential | Potential Impact | Treatments |
|---|---|---|---|---|---|
| (Effects based on peak surface temperatures of brush fires of 705°C from Jackson 1998:9 and DeBano et al. 2005:35) | | | | | |
| **Prehistoric** | Habitation site/ camps | Midden | | Low | |
| | | Obsidian | Loss of hydration rim, cracking, shattering | High | AC, FR, R, BZ, FB, SR, BB, M |
| | | Basalt | Spalling, oxidation, cracking, color changes | High | AC, FR, R, BZ, FB, SR, BB, M |
| | | Chert | Fracture, color changes, shattering | High | AC, FR, R, BZ, FB, SR, BB, M |
| | | Shell | | Low | |
| | | Faunal bone | Charring, chalky appearance, calcination | High | FR, R, BZ, FB, SR, BB, M |
| | | Groundstone | Spalling, crazing, discoloration, fracturing | High | AC, FR, R, BZ, FB, SR, BB, M |
| | | Human remains | Charring, chalky appearance, calcination | High | FR, R, BZ, FB, SR, BB, M |
| | | Bedrock mortar | Spalling, crazing, discoloration, fracturing | High | FR, R, BZ, FB, SR, BB, M |
| | | Wooden feature | Burning | High | FR, R, BZ, FB, S, *SR, BB, FF, M |
| | Trail | Earth | | Low | |
| | Lithic scatter | Obsidian | Loss of hydration rim, cracking, shattering | High | AC, FR, R, BZ, FB, SR, BB, M |
| | | Basalt | Spalling, oxidation, cracking, color changes | High | AC, FR, R, BZ, FB, SR, BB, M |
| | | Chert | Fracture, color changes, shattering | High | AC, FR, R, BZ, FB, SR, BB, M |
| | Chert quarry | Chert | Possible fracturing and color change | High | FR, R, BZ, FB, SR, BB, M |
| **Ranching** | Building | Wood | Burning | High | FR, R, BZ, FB, S, *SR, BB, FF, M |
| | | Glass | Melting | High | FR, R, BZ, FB, S, *SR, BB, FF, M |
| | | Steel (carbon) | | Low | |
| | | Iron | | Low | |
| | | Brick | Discoloration, cracks and fissures | High | FR, R, BZ, FB, S, SR, BB, M |
| | | Stone/cement | Spalling, cracking, discoloration | High | FR, R, BZ, FB, S, SR, BB, M |
| | | Foundation | | | |
| | Wooden fence | Wood | Burning | High | FR, R, BZ, FB, S, *SR, BB, FF, M |

| HISTORIC CONTEXT | RESOURCE TYPE | ELEMENT | Impact Potential | Potential Impact | Treatments |
|---|---|---|---|---|---|
| | | Iron nail | | Low | |
| | Utility pole | Wood | Burning | High | FR, R, BZ, FB, S, *SR, BB, FF, M |
| | Orchard/ fruit tree | Wood | Burning | High | FR, R, BZ, FB, S, *SR, BB, M |
| | Cement cistern | Cement | Spalling, cracking, discoloration | High | FR, R, BZ, FB, S, SR, BB, B, M |
| | Cement water trough | Cement | Spalling, cracking, discoloration | High | FR, R, BZ, FB, S, SR, BB, B, M |
| | Embankment | Earth | | Low | |
| **Ranching (con't)** | Lyons gravestone | | Spalling, cracking, discoloration | High | FR, R, BZ, FB, S, SR, BB, M |
| | Historic-era artifact concentration | Glass | Melting | High | AC, FR, R, BZ, FB, S, SR, BB, M |
| | | Solder (tin alloy) | Melting | High | AC, FR, R, BZ, FB, S, *SR, BB, M |
| | | Tin | Melting | High | AC, FR, R, BZ, FB, S, *SR, BB, M |
| | | Lead | Melting | High | AC, FR, R, BZ, FB, S, *SR, BB, M |
| | | White pot metal | Melting | High | AC, FR, R, BZ, FB, S, *SR, BB, M |
| | | Zinc | Melting | High | AC, FR, R, BZ, FB, S, *SR, BB, M |
| | | Aluminum | Melting | High | AC, FR, R, BZ, FB, S, *SR, BB, M |
| | | Brass | | Low | |
| | | Silver | | Low | |
| | | Copper | | Low | |
| | | Cast Iron | | Low | |
| | | Steel (stainless) | | Low | |
| | | Porcelain | | Low | |
| | | Iron | | Low | |
| | | Wood | Burning | High | FR, R, BZ, FB, S, *SR, BB, M |
| | Stock pond | Earth | | Low | |
| **Military** | Building | Concrete | Spalling, cracking | High | FR, R, BZ, FB, S, SR, BB, M |
| | | Aluminum | | Low | |

| | | | | | |
|---|---|---|---|---|---|
| | | Steel (carbon) | | Low | |
| | | Iron | | Low | |
| | | Wood | Burning | High | FR, R, BZ, FB, S, *SR, BB, FF, M |
| | | Cinderblock | Spalling, cracking | High | FR, R, BZ, FB, S, SR, BB, M |
| **Logging and Mining** | Skid road | Earth | | Low | |
| | R.R. grade | Earth | | Low | |
| | R.R. track | Iron | | Low | |
| | | Steel (carbon) | | Low | |
| | R.R. sleeper | Wood | Burning | High | FR, R, BZ, FB, S, *SR, BB, FF, M |
| | Logging equipment | Steel (carbon) | | Low | |
| | | Iron | | Low | |
| **HISTORIC CONTEXT** | **RESOURCE TYPE** | **ELEMENT** | **Impact Potential** | **Potential Impact** | **Treatments** |
| **Logging and Mining (con't)** | Bridge | Wood | Burning | High | FR, R, BZ, FB, S, *SR, BB, FF, M |
| | Tailings/mine waste | Stone | Spalling, cracking | High | FR, R, BZ, FB, SR, BB, M |
| | Ditch | Earth | | Low | |
| | Adit | Earth | | Low | |
| **Ethnographic / Traditional Resources** | Basketry and food | Vegetation | Burning/ Native American concerns | High | FR, R, BZ, FB, SR, BB, C, M |
| | Goose pen (hollow tree) | Wood | Burning/ Native American concerns | High | FR, R, BZ, FB, SR, BB, C, M |
| | Ceremonial/spiritual | Landscape | Burning/Native American concerns | High | FR, R, BZ, FB, SR, BB, C, M |

***SR=** Chemical suppressants/retardants should only be used in case of an emergency. These chemicals could cause adverse effects to historic-era wooden structures and metal equipment.

**Note:** While treatments vary by material type, it is important to consider all the elements for each given resource.

**KEY**

**Low** = No or minor impact is likely

**High** = Impact is likely

**AC** = Artifact collection

**FR** = Fuel reduction/mechanical thinning

**R** = Redesign

**BZ** = Buffer zone

**FB** = Fire break

**S** = Sprinkler

**SR** = Suppressant and fire retardant

**BB** = Back burning

**FF** = Fire fabric/wrap

**B** = Burial

**C** = Consultation

**M** = Monitoring

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Table 14.

**Cultural Resources at Risk from Timber/Woodland Fires. Effects Identification Matrix. Redwood National Park.**

| HISTORIC CONTEXT | RESOURCE TYPE | ELEMENT | Impact Potential | Potential Impact | Treatments |
|---|---|---|---|---|---|
| (Effects based on peak surface temperatures of mixed conifer fires of 200-800°C from Buenger 2003:312) | | | | | |
| **Prehistoric** | Habitation site/ camps | Midden | | Low | |
| | | Obsidian | Loss of hydration rim, cracking, shattering | High | AC, FR, R, BZ, FB, SR, BB, M |
| | | Basalt | Spalling, oxidation, cracking, color changes | High | AC, FR, R, BZ, FB, SR, BB, M |
| | | Chert | Fracture, color changes, shattering | High | AC, FR, R, BZ, FB, SR, BB, M |
| | | Shell | Discoloration, calcination | High | FR, R, BZ, FB, SR, BB, M |
| | | Faunal bone | Charring, chalky appearance, calcination | High | FR, R, BZ, FB, SR, BB, M |
| | | Groundstone | Spalling, crazing, discoloration, fracturing | High | AC, FR, R, BZ, FB, SR, BB, M |
| | | Human remains | Charring, chalky appearance, calcination | High | FR, R, BZ, FB, SR, BB, M |
| | | Bedrock mortar | Spalling, crazing, discoloration, fracturing | High | FR, R, BZ, FB, SR, BB, M |
| | | Wooden feature | Burning | High | FR, R, BZ, FB, S, *SR, BB, FF, M |
| | Trail | Earth | | Low | |
| | Lithic scatter | Obsidian | Loss of hydration rim, cracking, shattering | High | AC, FR, R, BZ, FB, SR, BB, M |
| | | Basalt | Spalling, oxidation, cracking, color changes | High | AC, FR, R, BZ, FB, SR, BB, M |
| | | Chert | Fracture, color changes, shattering | High | AC, FR, R, BZ, FB, SR, BB, M |
| | Chert quarry | Chert | Possible fracturing and color change | High | FR, R, BZ, FB, SR, BB, M |
| **Ranching** | Building | Wood | Burning | High | FR, R, BZ, FB, S, *SR, BB, FF, M |
| | | Glass | Melting | High | FR, R, BZ, FB, S, *SR, BB, FF, M |
| | | Steel (carbon) | | Low | |
| | | Iron | | Low | |
| | | Brick | Discoloration, cracks and fissures | High | FR, R, BZ, FB, S, SR, BB, M |
| | | Stone/cement | Spalling, cracking, discoloration | High | FR, R, BZ, FB, S, SR, BB, M |
| | | Foundation | | | |
| | Wooden fence | Wood | Burning | High | FR, R, BZ, FB, S, *SR, BB, FF, M |

| HISTORIC CONTEXT | RESOURCE TYPE | ELEMENT | Impact Potential | Potential Impact | Treatments |
|---|---|---|---|---|---|
| | | Iron nail | | Low | |
| | Utility pole | Wood | Burning | High | FR, R, BZ, FB, S, *SR, BB, FF, M |
| | Orchard/ fruit tree | Wood | Burning | High | FR, R, BZ, FB, S, *SR, BB, M |
| | Cement cistern | Cement | Spalling, cracking, discoloration | High | FR, R, BZ, FB, S, SR, BB, B, M |
| | Cement water trough | Cement | Spalling, cracking, discoloration | High | FR, R, BZ, FB, S, SR, BB, B, M |
| | Embankment | Earth | | Low | |
| **Ranching (con't)** | Lyons gravestone | | Spalling, cracking, discoloration | High | FR, R, BZ, FB, S, SR, BB, M |
| | Historic-era artifact concentration | Glass | Melting | High | AC, FR, R, BZ, FB, S, SR, BB, M |
| | | Solder (tin alloy) | Melting | High | AC, FR, R, BZ, FB, S, *SR, BB, M |
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| | | Copper | | Low | |
| | | Cast Iron | | Low | |
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| | | Porcelain | | Low | |
| | | Iron | | Low | |
| | | Wood | Burning | High | FR, R, BZ, FB, S, *SR, BB, M |
| | Stock pond | Earth | | Low | |
| **Military** | Building | Concrete | Spalling, cracking | High | FR, R, BZ, FB, S, SR, BB, M |
| | | Aluminum | | Low | |

| | | | | | |
|---|---|---|---|---|---|
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**B** = Burial

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**M** = Monitoring

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