Final Fire Management Plan
Environmental Impact Statement
Point Reyes National Seashore
and
North District of Golden Gate National Recreation Area

National Park Service
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Final Fire Management Plan and Environmental Impact Statement

Point Reyes National Seashore
North District of Golden Gate National Recreation Area
Marin County, California

Lead Agency: National Park Service

Revisions to the current fire management plan for Point Reyes National Seashore (PRNS) and the North District of Golden Gate National Recreation Area (GGNRA) are needed to meet public and firefighter safety, natural and cultural resource management goals, and wildland urban interface objectives of the park. The action alternatives in this Environmental Impact Statement (EIS) vary in the emphasis they place on seven fire management goals developed by the park. The current program has been effective in fire suppression, but has not fully guided fuel reduction and/or resource management programs.

This Fire Management Plan (FMP) and EIS describe and analyze a preferred alternative and two alternatives for future management of the fire program at PRNS and the GGNRA. The alternatives are: Alternative A (No Action) - Continued Fuel Reduction for Public Safety and Limited Resource Enhancement, Alternative B - Expanded Hazardous Fuel Reduction and Additional Natural Resource Enhancement and Alternative C - Increased Natural Resource Enhancement and Expanded Hazardous Fuel Reduction. The National Park Service prefers Alternative C.

Impact topics assessed in the EIS include natural resources including air, water, soil, vegetation, wetlands and special status species; cultural resources including archeological sites, historic structures, and cultural landscapes; park operations; and the socioeconomic environment.

The comment period on the FMP and EIS began February 20, 2004 with the publication of a Draft FMP and Draft EIS that lasted 60 days after the notice of availability. The comment period closed April 20, 2004. Comments and responses are presented in Chapter 5 of this Final FMP and EIS.

The release of this Final FMP/EIS and published Notice of Availability in the *Federal Register* will be followed by a 30-day no action period after which time the alternative or actions constituting the approved plan will be documented in a Record of Decision. For further information, contact the Superintendent, Point Reyes National Seashore, Point Reyes Station, CA 94956, or by phone at 415-464-5100.

Executive Summary

Final Fire Management Plan
Environmental Impact Statement

Point Reyes National Seashore
North District of Golden Gate National Recreation Area

Introduction

National Park Service policy requires that each park with vegetation capable of burning prepare a plan to guide a fire management program that is responsive to natural and cultural resource objectives, reduces risks to developed facilities and adjacent communities, and provides for public and staff safety. Point Reyes National Seashore is currently operating under a Fire Management Plan that was written in 1993. The 1993 plan addresses various fire management techniques, including fire suppression, prescribed fire, and limited use of mechanical treatments to reduce forest fuels. The National Park Service proposes to revise Point Reyes National Seashore's Fire Management Plan to expand the use of prescribed fire and mechanical treatment for all lands under its management.

Purpose of and Need for the Fire Management Plan

The purpose of the Fire Management Plan (FMP) is to provide a framework for all fire management activities for the Seashore and the North District of Golden Gate National Recreation Area (GGNRA), including suppression of unplanned ignitions, prescribed fire, and mechanical fuels treatments. It is intended to guide the fire management program for approximately the next 10-15 years. The plan would include concise program objectives, details on staffing and equipment, and comprehensive information, guidelines, and protocols relating to the management of unplanned wildfire, prescribed burning, and mechanical fuels treatment.

Fire management is an essential component of NPS operations in Point Reyes National Seashore (PRNS) and the Northern District lands of GGNRA. The need for a well-planned and effective fire management program is threefold. First, the project area's ecosystems have evolved through time with the periodic occurrence of fires, both natural and human-ignited, and many components of these systems require the continuation of periodic fire. As is typical of many national parks and other federal lands, however, active and effective fire suppression efforts for the past 150 years have dramatically changed native ecosystems. Ecosystem changes from the lack of fire include forest and shrub encroachment on grasslands, decadence and death of fire-adapted species, and extremely dense forests.

Second, fire suppression has also resulted in a dangerous accumulation of flammable or hazardous fuels - large quantities of dead and downed trees and branches that have accumulated in overly dense forests and shrublands. Because of these high fuel loads, residences and businesses adjacent to the PRNS and GGNRA are at risk from catastrophic wildfire or a smaller fire spreading from adjacent parklands. Also, a structural fire close to the park could spread into federal lands and develop into a wildland fire that damages park resources.

Third, the park's existing Fire Management Plan (NPS, 1993) needs to be updated. Since the current FMP was published in 1993, the national fire policies have been updated and new guidelines have been issued to park units. In addition, the NPS has conducted fire research and now has a better understanding of the role of fire in ecosystem preservation, resulting in a greater capability of the PRNS to conduct an effective fire program. Updating also allows PRNS to focus more heavily on effectively reducing fire risk along the wildland/urban interface, reducing hazardous fuels, and reestablishing fire in park ecosystems where it is safe to do so.

The following goals have been developed for the updated Fire Management Plan for PRNS and the Northern District lands of GGNRA. These goals were generated from internal staff meetings and public external scoping meetings and presentations, from review of NPS Policies, Directors Orders, and other fire-related guidance documents listed below.

- Goal 1: Protect firefighters and the public.
- Goal 2: Protect private and public property.
- Goal 3: Maintain or improve conditions of natural resources and protect these resources from adverse impacts of wildland fire and fire management practices.
- Goal 4: Maximize efforts to protect cultural resources from adverse effects of wildland fire and fire management practices.
- Goal 5: Foster and maintain effective community and interagency fire management partnerships.
- Goal 6: Foster a high degree of understanding of fire and fuels management among park employees, neighbors, and visitors.
- Goal 7: Improve knowledge and understanding of fire through research and monitoring and continue to refine fire management practices.

This final environmental impact statement (EIS) analyzes three alternative approaches to managing fire in the park. The alternative that is selected would be adopted as the new Fire Management Plan to guide the fire management program. Authority to develop a fire management program is derived from the National Park Service Organic Act (16 U.S.C. 1 et seq.), and in delegations of authority found in Part 245 of the Department of the Interior Manual. Director's Order 18 also provides guidance to National Park Service wildland fire management and Director's Order 12 guides National Park Service implementation of the National Environmental Policy Act (NEPA).

Decisions to be Made

The park superintendent will use information provided in this document, along with input received during the 60-day public comment period, to recommend to the Regional Director of the National Park Service the alternative that should be selected. The selected alternative would update the Fire Management Plan and guide fire management in the park over the next 10-15 years.

Planning Issues Considered

Planning issues are the concerns raised by park staff, other government agencies, and the public that were used to develop and evaluate the alternatives in this document. Concerns ranged from the impacts of wildland fire to the impacts associated with management actions taken to manage fire and reduce fuels. Planning issues discussed in this final document include impacts to the biological environment (vegetation, species of concern, wildlife), the physical environment (soils, water quality, and air quality), the cultural environment (cultural resources - historic and archeological), and the social environment (health and safety, regional economics, visitor experience, and visual resources).

Alternatives

Formulation of Alternatives

An interdisciplinary team of National Park Service staff developed the alternatives described in this document with input from the public and other agencies such as Marin County Fire Department and Inverness Fire Department. The interdisciplinary team was comprised of staff with expertise in fire management, wildlife, biology, botany, ecology, geology, safety, recreation, cultural resources, and public land policy and regulations. Public and interagency input was solicited and received through a scoping process. Three different approaches to managing fire at Point Reyes National Seashore were identified through this process.

Alternative A (No Action) - Continued Fuel Reduction for Public Safety and Limited Resource Enhancement

The National Environmental Policy Act requires that environmental analysis documents include a No Action alternative. The No Action alternative for plan modifications, such as the proposed update of Point Reyes National Seashore's Fire Management Plan, assumes that no new actions would be taken, but that current management would continue. The current fire management program outlined in the 1993 Fire Management Plan uses a limited range of fire management strategies - including prescribed fire, mechanical treatment, and suppression of all wildland fires (including natural ignitions). More specifically, existing practices include mechanical hazardous fuel(s) treatments on approximately 500 acres per year (primarily mowing in grasslands), and prescribed burning on approximately 500 acres per year (primarily for fuel reduction in grasslands and for Scotch and French broom control). The total treatments per year are approximately 1000 acres. Research projects already in progress on reducing Scotch broom and velvet grass through prescribed burning would continue under this alternative.

Alternative B - Expanded Hazardous Fuel Reduction and Additional Natural Resource Enhancement

Alternative B calls for a substantial increase over present levels in the reduction of hazardous fuels through prescribed burning and mechanical treatments (up to a total of 2,000 acres treated per year). Efforts would be concentrated in areas where unplanned ignitions are most likely to occur (e.g., road corridors) and where the creation of defensible space would be most effective at containing unplanned ignitions and protecting lives and property (e.g., around structures and in strategic areas along the park boundary). Natural resource enhancement would occur as a secondary benefit only. For example, in prescribed burns for fuel reduction along Highway 1, the non-native French broom would be eliminated as a secondary resource benefit.

Alternative C (Preferred Alternative) - Increased Natural Resource Enhancement and Expanded Hazardous Fuel Reduction

Alternative C would result in a marked increase in efforts to enhance natural resources, including increasing the abundance and distribution of T&E species, reducing infestations of invasive, non-native plants, and increasing native plant cover. Prescribed burning also would be used to protect or enhance cultural resources, such as reducing vegetation in areas identified as important historic viewscapes.

Alternative C also would include increased reduction of hazardous fuels in high priority areas (e.g., along road corridors, around structures, and in strategic areas to create fuel breaks). Up to 3,500 acres could be treated per year using prescribed fire and mechanical treatments. Under this alternative, research efforts would be expanded to determine the effects of fire on natural resources of concern (e.g., rare and non-native species) and to determine the effectiveness of various fuels treatments. Research results would be used adaptively to guide the fire management program in maximizing benefits to natural resources, while protecting lives and property.

Actions Common to All Alternatives

Some actions, including the continuation of the Wildland Urban Interface Initiative Program, maintenance of fire roads and trails, vegetation clearing around buildings, suppression of unplanned ignitions, public information and education, and fire monitoring would be carried out under all three alternatives. Also, the park intends to build a fire cache to store equipment regardless of the alternative selected. Each of these activities is described below.

Wildland Urban Interface Initiative Program

In 2001, the NPS began implementing provisions of the federal Wildland Urban Interface (WUI) Initiative program. Over the past three years, the NPS has funded over $2.0 million in fuel reduction projects in PRNS, GGNRA's North District, and adjacent lands. This program was designed to facilitate cooperative ventures with park neighbors (including other federal agencies, states, counties, private landowners, and local fire agencies) to reduce the potential for wildland fire to burn from federal lands to neighboring properties. In the future, the PRNS would continue to request funding for defensible space and fuel reduction projects on private lands adjacent to the park.

Maintenance of Fire Roads and Trails

The Seashore routinely clears vegetation and debris from selected dirt and paved roads (See Table 4) that provide routes for emergency evacuation, access for fire suppression activities or conducting prescribed burns, or that serve as control lines for prescribed fire projects. The minimum requirement for defensible space along roadways is 10 feet on each side. This specification provides only the minimum degree of safety for firefighters and the public and is prescribed by California Public Resource Code (PL-4290 and 4291). An assessment of road conditions is performed in early summer, and then a work plan is developed and vegetation clearing needs are prioritized.

Vegetation Clearing around Buildings

Seashore staff routinely clears hazardous fuels (vegetation and flammable debris) adjacent to structures within the project area. These actions would continue under all alternatives. Structural clearing conforms to or exceeds the requirements of California Public Resource Code (PL-4290 and 4291), which also dictates the parameters for structural safety in surrounding residential communities. This code requires a minimum 30-foot cleared buffer of defensible space around all structures.

Suppression of Unplanned Ignitions

The current policy at the Seashore is to suppress all unplanned ignitions using minimum impact suppression tactics (MIST) to the greatest extent possible. Since 1997, an average of three wildland fires per year have occurred at Point Reyes. All of these were kept less than ten acres in size; most were extinguished at less than one acre. To accomplish this, Point Reyes has had a 10-person Hazard Fuels Crew, 1-2 Engine Technicians, and support from the GGNRA and the Marin County Fire Department. Most of the fires occurred in the Olema Valley, and all but one were human-caused. Under all alternatives, all unplanned ignitions would be suppressed.

Public Information and Education

A comprehensive public information and education program would be included as part of all alternatives. PRNS and GGNRA share a full-time Fire Education Specialist. The program emphasizes fire safety and prevention, fuels management, the role of fire in PRNS's ecosystems, the Seashore's fire history, the cultural use of fire on the landscape, and fire research programs and opportunities.

Fire Monitoring

Monitoring of fire effects has been occurring in prescribed burn units at PRNS since 1991, and would continue under all alternatives. Monitoring of fuels, weather, air quality, and fire behavior for wildland and prescribed fires generally follows protocols outlined in the Fire Monitoring Handbook (NPS 2003a). Under these protocols, photo points and vegetation transect data are used to indicate attainment of objectives. Short and long-term objectives applicable to specific burn areas are stated in individual Prescribed Burn Plans.

Fire Program Cache

Currently, fire control vehicles and equipment are stored at the Hagmaier Complex, located approximately six miles from park headquarters. Storage of fire equipment and vehicles in a more central location of the park would decrease response time and facilitate communication between park staff responsible for fire management. Internal scoping discussions among specialists in different fields at the park indicated the cache should ideally be located near park headquarters for logistic and technical reasons. In addition, the environmental effects of siting the building near existing buildings would be minimal. At this time, the park staff has identified a location adjacent to the roads and trails facility at the Bear Valley administrative area (park headquarters) as its preferred choice for the cache.

Environmental Impacts

The environmental impact section of this EIS evaluates the degree of change a particular resource would experience if an alternative were implemented. The resources analyzed were identified by park staff, laws, regulations and policies, and the interested and affected public, including other agencies that were contacted during scoping.

NPS director's orders and management policies require analysis of whether an alternative might impair NPS values or resources, as this would be specifically prohibited by the Organic Act. As chapter 4 of this EIS indicates, none of the alternatives would impair park resources or values.

Chapter 3 of this EIS describes the resources and their current state, and chapter 4 analyzes the extent, duration and intensity of impacts to the resources expected under each alternative. A summary of major conclusions in each of these chapters is presented below.

Soils

Impacts to soils from the actions anticipated in each alternative include changes in soil productivity and chemistry, as well as erosion following the removal of vegetation. The total acreage of all FMUs where some treatment in at least one alternative would take place totals about 22,000 acres. The potential for erosion of soils following a wildland fire is higher in some FMUs than others, and is particularly high in the Wilderness North FMU, where 64% of the acreage is covered with soils that have very high erosion potential. Overall, about 10,000 acres in all FMUs have high erosion potential, 4,000 have very high erosion potential, and the remaining 7,000 have low or moderate potential for erosion.

The impacts of prescribed burning and average wildland fires (no more than about 30 acres per year) under Alternative A to soil from increased erosion would be negligible to minor. Impacts to soils from prescribed burning would be kept to no more than 10% of soils in watershed through the use of annual burn plans and NPS review under all alternatives. This mitigation measure would keep increases in soil erosion in this same range for Alternatives B and C as well, although as more acres are slated for prescribed burning, the impacts are progressively more likely to be minor rather than negligible.

Moderate to major, short- to long-term, adverse cumulative impacts to the physical, chemical, and biological properties of soils from a very large or catastrophic wildland fire are possible under any of the three alternatives, although the risk of such a fire and its likely extent both decrease as treatment from prescribed fire and mechanical thinning increase. In addition to increased erosion, formation of hydrophobic soils, gullying, channel cutting, slope failure, and destruction of organic material and microorganisms in the soil are likely in the event of this type of fire. Suppression activities could have additional adverse, short to long-term moderate to major impacts from soil compaction, mixing, reduced infiltration, loss of vegetation, and changes in soils that prevent quick revegetation. Actively suppressing wildland fires before they reach sensitive resources could keep impacts from becoming major and adverse.

Some of these same changes in soil productivity and chemistry would occur during prescribed burning or more average wildland fires, but to a much lesser extent. Because impacts would be monitored and kept to no more than 10% of a watershed, they would be negligible to minor for all three alternatives, although as described above for increases in erosion, they would be greater in Alternative C than B, and greater in Alternative B than A. Negligible to minor impacts to soils from compaction or other physical changes from mechanical treatments are also possible under any of the alternatives.

Air Quality

The predominant regional surface winds in the area are from the north-northwest during winter, spring and summer. In fall, warm easterly winds can break through to the coast while inland conditions remain hot and dry. These winds lower vegetation moisture levels and begin the season when the coastal region faces its most significant fire threat.

The westerly winds help disperse air pollution from coastal communities, as does vertical mixing, which is most prevalent during hotter weather or the heat of the day. During winter or during temperature inversions, pollutants concentrate nearer the ground.

Only $PM_{2.5}$ (particulates less than 2.5 microns in size) is measured at PRNS, and the park is well below state and federal standards. Other air pollutants are not measured in the study area, so those from the closest rural locations (Santa Rosa and Vallejo) were used as an approximation. Santa Rosa meets the federal average standard for particulates smaller than 10 microns, but is higher than California's more strict standards. It is well below both the maximum one-hour and eight-hour average federal and state standards for carbon monoxide, and the state and federal one-hour (state) and annual average (federal) standards for nitrogen dioxide. Vallejo is also well below the federal and California maximum 24-hour and annual average standards for sulfur dioxide. Santa Rosa has exceeded the state's maximum 24-hour ozone average of 50 $\mu g/m^3$ twice over the three-year period measured, and the California one-hour ozone standard once.

Particulate emissions generated annually under Alternative A from all FMP actions and wildfires would have a long-term, adverse but negligible effect on regional haze. Ranches and residences along Highway One and ranches east of Estero FMU could experience infrequent short-term, negligible to minor adverse nuisance smoke effects from prescribed burning.

The annual acreage treatment under Alternative A would not appreciably reduce the potential size or severity of a catastrophic wildfire even after a decade of implementation. The cumulative effect on air quality would be short-term, adverse and major at both Year 1 of implementation and at Year 10.

On an annual basis, Alternative B would generate higher levels of particulate emissions than the No Action Alternative (Alternative A), as twice as many acres would be subject to FMP actions each year. Alternative B would produce and average of 2.86 pounds of PM_{10} per acre managed, resulting in a long-term, adverse, minor effect on regional haze. This additional contribution would be offset by the long-term opportunity presented by Alternative B to achieve a major, beneficial reduction in the emissions that could result from a catastrophic fire as compared to the cumulative effect under Alternative A. Nuisance smoke would be an infrequent, short-term, adverse, negligible to moderate air quality impact for residents near prescribed burns during the duration of the burn.

On an annual basis, Alternative C would generate the highest levels of particulate emissions compared to the No Action Alternative A and Alternative B. This is a result of the greater number of acres treated each year and the larger number of forested acres, which produce the highest emission levels. Alternative C would produce an average 5.3 pounds of PM_{10} per acre managed, resulting in a long-term, adverse, moderate effect on regional haze. Contributions of PM_{10} to regional haze would be a long-term, adverse, and moderate for 13 years rather than the indeterminate period under Alternative A.

This additional contribution would be offset by the long-term opportunity presented by Alternative C to achieve a short-term, major, beneficial, cumulative effect on regional haze that could result from a catastrophic fire as compared to the emissions produced under the cumulative scenario in Alternative A.

Nuisance smoke would be an infrequent, short-term, adverse, negligible to moderate air quality impact for residents near prescribed burns during the duration of the burn.

Watersheds and Water Quality

Total Suspended Solids (TSS) and nitrogen in park water resources could be exacerbated by fire management activities. The ash generated by fires is rich in nitrogen, a nutrient essential to biotic reproduction. Excess nitrogen in a water body can increase production of algae and aquatic plants. When this excessive biomass decays, it can deplete a water body of oxygen and lead to fish kills. Sampling of several sites in the park showed that current nitrogen levels, measured as nitrate and nitrite, were below detectable limits (>0.2 mg/l) (Ketcham, 2001) except in one watershed supporting dairying operations.

Mechanical thinning and prescribed burning activities would also result in soil compaction, removal of vegetation and other changes that could increase erosion and suspended solids in water resources. Fire changes vegetation, forest floor cover (e.g., ground vegetation, litter or duff) and structure, and soil properties, all of which can alter the movement of water over, or into, the soil. In the first years following a large fire, watershed storage capacity is reduced and net surface runoff is increased as a result of reduced soil cover, lack of soil cover, and/or increased soil hydrophobicity (water repellency). These changes can result in channel extension, upland erosion, and stream channel incision. These changes to hillslope process result in increased discharges, soil erosion, and higher sediment yield, affecting aquatic habitat conditions within the watershed.

The heating of soils from prescribed or wildland fires can lead to development of a water repellent layer at or below the surface of the soil, a condition called hydrophobicity. This layer reduces the infiltration capacity of the soil and increases the potential for overland flow. The higher the fire intensity/severity, the deeper in the soil this layer will form.

Extremely high levels of sediments can also injure fish by clogging their gills, obscuring the presence of food, or covering the gravel surface of spawning areas. All watersheds sampled for the Point Reyes National Seashore Water Quality Monitoring Report (Ketcham, 2001) had TSS that exceeds the recommended standard. Sampled watersheds were Lagunitas Creek, Olema Creek, Drakes Estero, Drakes Bay, and Pacific Drainages. Sediment data were not collected from the Bolinas Drainages, Pine Gulch Creek, or Tomales Bay watersheds.

These types of impacts would occur on a small-scale from prescribed burning in Alternative A, and would be negligible to minor and short-term. Trampling and the removal of vegetation would also result in some negligible to minor, short-term localized increases in erosion. However, in any alternative, a large-scale unplanned fire could have adverse, potentially long-term, and major impacts to both water quality and features of watersheds, including riparian zones and watercourses. Fire management activities would reduce the risk of this much larger watershed level impact. In this regard, Alternative A could provide moderate, long-term benefits to watersheds and water quality through prescribed burning, and additional minor to moderate benefits from mechanical thinning.

In the context of the 90,000 acre study area, the impacts to water quality and watershed characteristics of Alternative B or C would be nearly indistinguishable from Alternative A. In other words, over the entire study area, any alternative would provide a combined moderate to major benefit to watersheds through the use of prescribed burning and mechanical treatment in reestablishing natural hydrological processes and reducing fuel loads and potential for catastrophic wildfire. Each could also result in minor, adverse, short-term impacts to water quality from ash or increases in erosion and suspended solids. Because the treated acreage would be larger in Alternative B than Alternatve A, and larger still in Alternative C, benefits and adverse impacts could be quite noticeable on a localized basis.

Vegetation

PRNS owes much of its distinctive character to the assemblage of plants that occur on the Peninsula. The Seashore is home to over 910 plant species, 55 of which are of management concern. Of the 910 plant species, roughly one third are not native to the area. Nine broad vegetation communities are addressed in the EIS. They are Bishop pine forest, Douglas-fir and coast redwood forest, hardwood forest, Monterey pine and Monterey cypress, riparian forests and shrublands, coastal scrub, California coastal prairie, pasture, and coastal dunes.

Vegetation mapping in the park indicates approximately 3,570 acres of Bishop pine forest occurring within Seashore boundaries. In 1995, approximately 35% (1,250 acres) of this acreage was burned in the Vision Fire. Fire plays an important ecological role in maintaining Bishop pine forests, and regeneration in the burned area has been prolific.

The Douglas-fir (*Pseudotsuga menziesii*) and Coast redwood (*Sequoia sempervirens*) forest is the most common forest type in the project area. Douglas-fir is shade intolerant and requires stand-destroying disturbance (e.g., wildfire, logging, extensive windthrow) to initiate a new cohort of seedlings. Coast Douglas-fir can survive moderately intense fires, particularly if they are more than about 100 years old. However, most cannot withstand a crown fire. This is a risk in the project area, where many stands have substantial ladder fuel accumulations.

Hardwood forest, usually dominated by California bay, coast live oak, or eucalyptus, occupies about 1900 acres of the 21,000+ acres that may be treated through fire management activities in the study area. Eucalyptus is notable because it is an invasive non-native species, and would be treated in some alternatives by thinning and herbicide application to prevent stump resprouting.

Monterey pine and Monterey cypress are both introduced species in the area. These forests occur over a small portion of the FMUs slated for treatment. Monterey pine cones are only opened when exposed to heat such as fire or high air temperature.

Broad-leaved deciduous trees or shrubs such as red alder, mixed willows, and arroyo willows, dominate riparian forests and shrublands. Red alder quickly invades forest openings, such as those created from fires. Its seeds can travel several hundred yards in wind to recolonize these disturbed areas. Most willows resprout from the root crown or stem base following fire. They are also prolific seeders, and off-site plants are important as a seed source for revegetating burned areas.

Coastal scrub is a highly variable vegetation type including all of the shrublands of the study area and a small amount of chaparral. Coastal scrub is one of the most widespread plant community types in the project area and is present to some degree in all FMUs. Coastal sage and coastal scrub community types are fire-dependent, with prominent shrubs establishing by seed and sprouting. They are flammable vegetation types that may burn again 1 to 2 years after fire if dry conditions exist.

Pristine coastal prairie in the study area is dominated by perennial bunchgrasses, but non-native grasses dominate roughly 80% of the grasslands in the Seashore.

Pasture is distinguished from grazed grasslands and other grazed naturally occurring vegetation types in the project area as it is used to graze cattle or horses, or managed to produce silage for cattle, or used for other agricultural purposes. Very little pasture is in the treatable area identified in this plan/EIS, although the Minimum Management FMU is predominately pasture.

Coastal dunes are dominated by non-native species, in particular European beachgrass and non-native iceplant. Remnant patches of native plants covering about 25% of this vegetation community exist.

Under the continuation of existing management described in Alternative A, prescribed burning would be used to manage hazardous fuels along primary roads and reduce the aerial extent and density of non-native invasive plant species, including Scotch broom, French broom, and Monterey pine. In Alternative B, burning would be conducted in the same FMUs for the same reasons as in Alternative A, although significantly more burning in shrublands and grasslands in Limantour Road and Bolinas Ridge FMUs would occur, primarily to reduce fuels. In addition to more treatment to reduce fuels and increase the ability to fight wildfires, under Alternative C the Seashore would use fire to enhance the condition of natural and cultural resources. Some treatment of natural resources would involve the widespread attempt to eliminate non-native species, but treatment to improve species richness and wildlife habitat also would occur.

The focus of mechanical treatment in Alternative A would be mowing grasslands to reduce hazardous fuels and control Scotch and French broom, as well as cutting Monterey pine to help eliminate this non-native species. This would remain true of Alternatives B and C as well, although progressively more acreage would be treated in each.

In the FMUs treated with prescribed fire, minor, short-term adverse impacts associated with loss of vegetation, as well as the possibility of introduction or spread of non-native plants, could be greater than under other alternatives. However, the burns also would result in minor to moderate beneficial impacts as burning would stimulate growth of many native plant species, and would kill non-native vegetation. Although they would remain moderate, the potential for beneficial effects from Alternative B are greater than Alternative A, and from Alternative C are greater than either of the other alternatives because of the increasing number of acres treated.

Mechanical fuel reduction would have minor short-term adverse impacts on native vegetation through crushing or other physical impacts, but clearing of dense vegetation also would have possibly long-term, minor to moderate benefits on most plant communities as well. The effects would be greater in Alternative C than under Alternative B, and greater under Alternative B than Alternative A because more acres would be treated.

Treatment of non-native Scotch broom with prescribed fire has been successful, and would provide minor to moderate benefits to coastal scrub and grassland habitat in any alternative. Mechanical treatment of Scotch and French broom in coastal scrub, grasslands, and pasture would provide additional moderate to major benefits to these vegetation communities. Additional minor benefits to coastal scrub from prescribed burning to increase native species richness in Alternatives B and C would occur in Palomarin and Bolinas Ridge FMUs. Prescribed burns and mechanical treatments in grasslands could have beneficial or adverse impacts, as results are highly variable. Monitoring and adaptive management would keep these impacts from becoming more than minor if they are adverse.

Limited prescribed burning in Alternative A may have negligible benefits to hardwood, Douglas fir, or Bishop pine forests from decreasing fuel loads. This would increase to minor or moderate benefits in the other two Alternatives as fuel reduction would take place over a larger area. Additionally, possible major benefits to Douglas-fir forests from the return of natural fire intervals following treatment with prescribed burning are possible in Alternative C. In all alternatives, mechanical fuel reduction could have negligible to minor short-term adverse impacts to hardwood and other forests (including Bishop pine and Douglas-fir forests) from trampling, or from the inadvertent introduction and spread of non-native species.

All alternatives would result in minor to moderate localized benefits to native vegetation from the removal of Monterey pine and cypress trees. For these beneficial impacts to persist, however, follow-up activities must be conducted to remove new recruits that come into the site in years following prescribed burning or mechanical treatments.

Alternatives B and C would offer minor benefits to coastal dune vegetation from the burning of non-native beachgrass.

The risk of a catastrophic wildfire would progressively decrease as more acres are subject to prescribed burning or mechanical treatment. In some native vegetation communities, such as Bishop pine or hardwood forest, large-scale fire could be beneficial by eliminating non-native species or otherwise creating conditions favoring the spread of native plants. In others, such as Douglas-fir/coast redwood forests, hot crown fires can destroy the seed source for a large area, making re-establishment difficult. Riparian areas may also experience major adverse impacts from hot fires from the destruction of seed source or root crown. The effect of a wildland fire in coastal scrub or grassland is more complex and less well understood, as some native and non-native species are benefited and some are adversely affected. Overall, the cumulative effects of a large-scale fire and all other activities such as development, historic logging, disease, and the introduction of exotics have and would continue to have major, long-term, adverse impacts on native vegetation communities in the park. Alternative B and C would reduce the risk of such a fire, but should it occur, the impacts on most vegetation communities at the Seashore would be major, long-term and adverse.

Wetlands

Wetlands, including salt and fresh-water wetlands, make up about 300 acres of the study area. Impacts to wetlands associated with fire management activities are similar in many respects to impacts described in the preceding sections on soils and vegetation. Impacts on wetland sites, however, can differ from impacts on upland sites because wetlands usually have a higher level of soil moisture and denser vegetation cover than non-wetlands, which can result in variable impacts. These conditions can result in wetlands being more vulnerable to impact from certain activities. Wetlands are also considered unique habitats that support a diversity of vegetation and wildlife species, and so are protected by the Clean Water Act and other laws and policies.

No burning or mechanical treatment in wetlands is prescribed in any of the alternatives; however, wetlands do occur in treated areas, and vegetation in some small wetlands may unintentionally be burned. Thinning may be required to reduce the risk of prescribed burns encroaching on wetland vegetation.

In all three alternatives, short-term, minor adverse impacts from unintentional burning of vegetation are possible, especially in dry years. However, some research and observations at the Seashore indicate wetland vegetation can be thinned and stimulated to reproduce by low or moderate intensity fires. These same fires can destroy non-native plants in wetlands. Minor to moderate short to long-term benefits on wetland vegetation from prescribed burning or even small wildfires in an average year are therefore possible in all three alternatives. In both adverse effects and beneficial effects, the degree of impact is greater the more acreage treated; therefore beneficial impacts are more likely to be moderate in Alternative C than A, for example.

Minor short-term adverse impacts on wetlands from unplanned wildfires and their suppression could occur in any alternative. Minor beneficial effects also could occur due to reduction of non-native plant species or stimulation of germination and resprouting in native species.

Mechanical treatments would avoid wetland areas to the greatest extent possible. If such treatments in wetlands were deemed necessary to ensure fire safety around structures or along roads, these treatments would have negligible to minor short-term adverse impacts on vegetation in Alternative A, and minor adverse impacts in Alternatives B or C. Clearing vegetation also could have minor short-term benefits to wetland species if native species establishment is enhanced in all three alternatives.

Cumulative impacts from development in the park may have a minor adverse impact on wetlands. However, a large-scale wildfire could have major, long-term adverse impacts on wetlands from destruction of vegetation and reproductive ability, and invasion by non-native species.

Wildlife

The project area supports a wide diversity of wildlife species, including 28 species of reptiles and amphibians, 65 species of mammals, and breeding habitat for 130 species of birds. Nearly 490 bird species (representing 45% of the avian fauna documented in the United States) have been sighted on land and over near shore waters at Point Reyes. PRNS is also home to innumerable invertebrates. The waters of the Pacific Ocean and Tomales Bay support rich and diverse fisheries.

Generally, the effects of fire on wildlife depend on the characteristics of the fire itself (e.g., intensity, duration, frequency, size, shape, season, and time), the characteristics of the vegetation or habitat burned, and on species characteristics (e.g., size, mobility, habitat preferences). The types of impacts to wildlife can be direct or indirect. Direct impacts include incineration, asphyxiation, injury, or avoidance of an area, and are most often experienced by less mobile species or life stages. Wildlife may also experience indirect effects. For example, fish or aquatic invertebrates can be harmed by sedimentation in a creek due to post-fire soil erosion, or carnivores can suffer from reductions in the prey base as a result of either direct mortality of the prey, or a reduction in the food and cover resources used by the prey species.

Habitat loss itself is a possible adverse indirect impact from fire, and can be short- or long-term. Changes in vegetation structure and composition, down and dead woody material, and snags that occur after the fire can all affect wildlife. In particular, the loss of down and dead woody material and snags during a prescribed burn remove essential structural habitat components for a variety of wildlife and reduce species diversity (McMahon and deCalesta, 1990). Depending on the season, a fire can also have adverse effects on a species' nesting or reproductive success. The nature of the fire, e.g., its severity, patchiness, whether it is a crown or understory fire, etc., will also determine if ground-dwelling or canopy-dwelling species are affected. If wildland fires burn extensive areas, and/or the fire is of high intensity, entire populations or subpopulations of wildlife can be affected.

Wildlife can also benefit from fire. For instance, populations of species dependent on early seral stage vegetation increase following a burn. Vegetation that grows in the first 2-10 years after a burn often contains higher levels of nitrogen, which can cause increases in some herbivore populations. Decreased cover can improve the growth of forage and can improve predator hunting success. Decreased parasite loads and increased dispersion in some species can diminish disease levels.

Hot, stand replacing fires, which become more likely with increased fuel loads, can type change the vegetation (e.g., a forest that changes to brush/grassland after a severe fire), and can have a long-term adverse impacts on fauna that thrived on the pre-fire habitat type. Patchy low intensity fires do not dramatically alter landscapes, remaining unburned vegetation provides habitat for existing species, and impacts are relatively minor and short-term. Evidence suggests that maintenance of a variety of successional stages with patchy fire patterns ensures the highest levels of wildlife biodiversity (Nichols and Menke, 1984). In other words, patchy, low intensity fires can provide long-term benefits to a variety of wildlife.

Under Alternative A, prescribed fire and mechanical treatment would have a beneficial, short or long-term minor impact on wildlife by creating more open habitat and reducing the risk of catastrophic fire. Short-term minor adverse impacts on species using existing down wood or dense forest habitat are also likely.

Some wildfire suppression activities or actions to control prescribed burns, such as spike camps, access or creating fire lines, would have short-term adverse and, therefore, minor impacts on wildlife. Others, such as creating helispots or the use of helicopter buckets of water or retardants, may have longer lasting impacts. Overall, these activities are not expected to have more than minor impacts to wildlife. This is true of Alternatives B and C as well. Impacts would remain minor, but be greater in Alternative B than A, and greater in Alternative C than B. Actions to suppress large fires would likely be more intense, with short-term major or long-term moderate adverse impacts to wildlife.

The machinery used for chipping and shredding would be loud, which would have negligible, short-term impacts to some species, such as nesting birds, through disturbance.

In the context of the 90,000 acre study area, the impacts to wildlife of Alternative B would be nearly indistinguishable from Alternative A. Treatment with prescribed fire and through mechanical means would result in short- to long-term, negligible to minor benefits to wildlife from the reestablishment of the natural fire cycle, reduction of fuel loads, and reduction of the potential for catastrophic wildfire. However, compared to No Action, Alternative B could offer moderate short- to long-term benefits to wildlife because twice as many acres would be treated (up to 2000 pre-year total; 2% of total acres managed) and effects would be noticeable on a local scale. Forest dwelling species would suffer negligible to minor short-term adverse impacts from reductions in habitat overall, and minor to moderate impacts relative to those from the No Action alternative.

In the context of the entire study area, Alternative B would result in negligible to minor short- to long-term benefits to wildlife from creating open habitat using mechanical thinning. Compared to Alternative A, these benefits could be moderate.

Treatment with prescribed fire and through mechanical means in Alternative C would result in short- to long-term, minor to moderate benefits to wildlife from the reestablishment of the natural fire cycle, reduction of fuel loads, and reduction of the potential for catastrophic wildfire. However, compared to No Action, Alternative C could offer moderate to major short- to long-term benefits to wildlife because up to four times as many acres would be treated (3500 total; 3.5% of total acres managed) and be noticeable on a local scale. Forest dwelling species would suffer minor to moderate short-term adverse impacts from reductions in habitat overall, and moderate or even major localized impacts relative to those from the No Action Alternative A.

In the context of the entire study area, Alternative C would result in minor short to long-term benefits to wildlife from creating open habitat using mechanical thinning. Compared to Alternative A, these benefits could be moderate.

Special Status Species

The study area supports 47 federally listed animal species - 14 are listed endangered, 8 are threatened, and 24 are “species of concern.” Among these are the endangered Brown Pelican (*Pelecanus occidentalis*) and Myrtle’s silverspot butterfly (*Speyeria zerene myrtleae*). Federally threatened species include Northern spotted owl (*Strix occidentalis*), Western snowy plover (*Charadrius alexandrinus*), and California red-legged frog (*Rana aurora draytoni*). Nineteen federally listed plant species (seven of which also are state listed) and an additional 25 species listed or proposed for listing by the California Native Plant Society (CNPS) have been documented in the study area.

Federally listed plants in the study area that may be affected by fire management activities include Sonoma alopecurus (*Alopecurus aequalis* var. *sonomensis*), Sonoma spineflower (*Chorizanthe valida*), robust spineflower (*Chorizanthe robusta*), Tiburon paintbrush (*Castilleja affinis* ssp. *neglecta*), Marin dwarf flax (*Hesperolinon congestum*), beach layia (*Layia carnosa*), and Tidestrom's lupine (*Lupinus tidestromii* [var. *layneae*]). Others are listed as federal "species of concern." Species of concern are species for which USFWS is collecting additional information to determine if they warrant consideration for future listing. In addition, two species (Point Reyes blennosperma and Mason's ceanothus) are considered rare by the state of California and one species is state endangered (Point Reyes meadowfoam). In Alternative A, although no federal or state listed species have been found in FMUs that would be treated with prescribed fire, one state rare species (Mason's ceanothus) is present in the Bolinas Ridge FMU. Mason's ceanothus does not occur in any FMUs slated for mechanical treatment in this alternative. Several federal species of concern are present in Estero and Limantour Road FMUs, which would be treated with both prescribed fire and mechanical thinning.

The following threatened or endangered animal species are listed under the federal Endangered Species Act and may experience impacts from fire management activities: Northern spotted owl (*Strix occidentalis caurina*), California red-legged frog (*Rana aurora draytonii*), Central California coho salmon (*Oncorhynchus kisutch*), Central California Coast steelhead (*Oncorhynchus mykiss*), California freshwater shrimp (*Syncaris pacifica*), Myrtle's silverspot butterfly (*Speyeria zerene myrtleae*), and Western snowy plover (*Charadrius alexandrinus nivosus*). The Seashore is also home to many animal federal species of concern and those listed by the state of California. One species in particular from this list, the Point Reyes mountain beaver is discussed in more detail because it may be more likely than other species to experience effects from fire or fire management activities.

Fire management activities have potential to affect these species in the ways identified above in the sections on vegetation, wetlands, and wildlife. For example, several of these species occupy stream or riparian habitat, which could be adversely affected by increased sedimentation in creeks and/or persistent turbidity following wildland or prescribed fire. Fire management activities such as cutting fire line or removing vegetation to reduce fuel accumulations could destroy or harm individuals or damage their habitat. Conversely, as is the case for common plants and wildlife, many special-status species in the project area are adapted to periodic fire, and application of fire to the ecosystems could benefit these species by providing a wider diversity of habitats, by stimulating seed germination, or by improving habitat for prey species.

All known individuals of the seven federally threatened and endangered plant species in the study area occur only in the Minimum Management FMU, so would not be subject to either prescribed burning or mechanical fuels treatments. The populations could be subject to impacts associated with an unplanned wildfire or by fire suppression activities, but this is unlikely because the populations occur in wet sites, within pastures routinely grazed by cattle, or in beaches or rocky outcroppings where fire is unlikely to carry.

Plant species that are not federally listed, but are of concern are more likely to benefit from prescribed burning, as the Point Reyes ecosystem evolved in a regime that included frequent low-intensity fires. As progressively more of the study area is treated, natural fire cycles and intensities would be more likely over a wider area. Therefore, benefits from Alternative C would be greater than Alternative B, and Alternative B greater than Alternative A, although all would be minor on a landscape scale. Some patches or individuals of these species may experience minor, adverse effects from destruction through fire or suppression, or from the inadvertent stimulation of invasive exotic species by burning in any of the alternatives.

In Alternative A, prescribed fire and mechanical treatments would offer negligible to minor, long-term benefits on a limited scale to Northern spotted owls, red-legged frogs, and California freshwater shrimp (from fire only) by reducing the threat of catastrophic fire and the resultant habitat destruction. This benefit would increase as the number of acres treated increases, to minor benefits in Alternative B and moderate benefits in Alternative C. Mechanical treatments such as hand thinning and pile burning (actions taken to manage prescribed fire) could have a minor, short-term adverse effect on owls through human disturbance, reduction of prey species, and habitat alteration in unknown roosting and nesting sites; and on frogs from inadvertently killing individuals in all three alternatives. Large-scale wildfires could have more serious adverse effects on owls by eliminating habitat, and on frogs by burning riparian vegetation and increasing sedimentation in any of the alternatives. Both these species experience a positive cumulative impact from the large blocks of conservation land adjacent to the study area.

Under any alternative, adverse impacts to coho salmon and steelhead trout from prescribed burning would be negligible to minor, as riparian vegetation would be retained. Negligible positive benefits from reducing the risk and extent of a catastrophic burn would result from both prescribed burning and mechanical thinning. A large-scale wildfire would have more serious adverse effects by increasing siltation of streams and burning riparian vegetation, which in turn would increase water temperature.

Both Myrtle's silverspot butterfly and snowy plovers occur only in the Minimum Management FMU, and would not be subject to either prescribed burning or mechanical fuel treatments in any alternative. The populations could be subject to impacts associated with an unplanned wildfire or by fire suppression activities, but this is unlikely because the populations occur within pastures routinely grazed by cattle (silverspot) or beach areas (plover) where fire is unlikely to carry.

The impacts of fire management activities, including those of average size and intensity wildfires in the study area on Point Reyes mountain beaver would be kept to no more than minor and short-term through the use of mitigation measures in any alternative. Large-scale wildfires could have moderate adverse impacts that may be long-term.

There would be some indirect long-term benefits by conducting research and fire education. There are no adverse impacts to special status species by the construction of the fire cache in any alternative.

Cultural Resources

The Seashore has recorded 124 prehistoric, terrestrial sites, and estimates an additional 41 to 123 occur within current park boundaries. These sites are either habitation or use sites that reflect Coast Miwok occupation or resource processing sites. Another 92 historic terrestrial archeological sites have been recorded, and it is estimated that another 5 to 37 sites are likely to exist within the boundaries of PRNS. These sites typically reflect historic occupations and use of the peninsula; first by homesteaders and dairy ranch communities, and later by government lighthouse and lifesaving personnel and private radio telecommunications companies. Park cultural resource staff has also documented nine known and recorded terrestrial archeological sites that contain both prehistoric and historic components (not necessarily related to each other). They estimate another 5 to 14 such sites exist within park boundaries, but have not yet been identified. PRNS also manages 39 cultural landscapes; 23 are within the boundaries of Point Reyes National Seashore and 16 are within the North District of GGNRA. The landscapes primarily reflect the maritime, ranching, communications, and military history of the park.

The intensity of a fire and susceptibility of resources to heat ultimately determines the degree of damage from the direct effect of fire. In general, the longer a cultural resource is exposed to heat, the greater the likelihood of damage. Fire can result in the complete elimination of an artifact or feature (e.g., through consumption) or can alter attributes of an artifact or feature such that important research (e.g., obsidian hydration rinds, residues on pottery, bone burning) is hindered, or traditional (e.g., Native American spiritual sites) or other values are impacted.

The behavior of a fire (ground, surface, or crown) and proximity to a cultural resource are also important. While running surface fires and crown fires reach extreme temperatures (500 to 1500° C) and have high energy release rates, relatively little of that heat is directed towards the surface of the ground. Conversely, ground fires can result in long duration heating (400 to 700° C) within the upper 15 cm. of the soil profile. Ground or creeping active surface fires are usually associated with prescribed burns, whereas running surface and crown fires occur primarily during wildfires. Very generally, cultural resources located above the ground surface (e.g., rock imagery panels, historical structures) are most vulnerable to direct fire effects during crown and active surface fires, while ground and creeping surface fires threaten those found at or just below the ground surface (e.g., archeological sites). Because of this, the chances of adversely affecting a high percentage of cultural resources found exclusively on or near the ground surface are often greater. This is significant because cultural resources generally considered to have high data potential, such as Native American villages with subsurface components, may actually have a far lower percentage of artifact classes or attributes exposed to direct fire effects than a lithic scatter, often considered to have low data potential that is restricted to the ground surface.

Direct effects of fire management actions on cultural resources can also be beneficial, as mechanical thinning or reduction of fuels around important cultural resources can result in their preservation should a wildfire occur in the same area.

Impacts can also result from fire management operations, including mechanical thinning and fire suppression. These effects would generally be restricted to the displacement, breakage, and/or destruction and looting of cultural resources. Except in rare situations, operational effects are likely to be most pronounced on cultural resources found on and near the ground surface. Operational effects would be most likely to occur, and at the greatest intensity, during wildfires. This is due primarily to the fact that such actions are often carried out with little or no pre-planning and without consultation or supervision by a cultural resource specialist.

All alternatives would result in moderate short-term benefits to historic buildings by reducing fuels around these structures, both through prescribed burns and mechanical treatment. Benefits would remain moderate but be greater in Alternative C than Alternative B, and in Alternative B than Alternative A.

Mitigation measures would keep adverse impacts to archeological resources from pre-treatment prescribed burns, or mechanical thinning activities from becoming more than short-term and minor in Alternatives A and B. The potential for these impacts to archeological resources is moderate in Alternative C because more acres and FMUs are being treated.

Moderate long-term benefits to cultural landscapes such as grasslands from their restoration or maintenance of them through prescribed fire or mechanical treatments are also likely in all alternatives, although benefits would be greater in Alternative C than Alternative B, and greater in Alternative B than in Alternative A.

All alternatives could have negligible impacts to permanent major adverse effects on cultural resources, including historic structures and archeological resources from suppression activities associated with even average sized wildfires. Impacts to cultural landscapes, however, would be minor to moderate, as only a small portion of the landscape would be burned. Larger wildfires would be much more likely to result in major permanent impacts from the burning of historic structures, damage to buried resources, and the loss of a significant portion of cultural landscapes.

No adverse or beneficial effects are anticipated with the construction of the new fire cache or implementing research activities on historic structures, archeological sites, or cultural landscapes.

Visitor Use and Visitor Experience

The project area is unique not only in its assemblage of natural and cultural features, but also in its proximity to a major urban population. This juxtaposition makes PRNS's resources and recreational opportunities readily accessible to a large number of people, and enhances the importance of the special qualities for which it was set aside. Over 2.25 million people visit PRNS annually. Visitation estimates for 2002 found that the North District of the park (north of Bear Valley) receives roughly 60% of the overall visitation. Over 700,000 visitors went to the 3 park visitor centers and over 70,000 visitors have extended contacts with park interpretive staff through ranger-led programs.

The area supports 147 miles of hiking trails, backcountry campgrounds, and numerous beaches. Activities include hiking, water sports, horseback riding, fishing, camping, wildlife viewing, and other interpretive opportunities.

Hiking is primarily a day-use activity. Approximately 50 trails are designated throughout PRNS, and they encompass a range of habitat types from wooded mountains to sandy beaches. Overnight stays are available through four backcountry campgrounds: the Stewart Horse Camp, the Point Reyes Hostel, a private campground, and local hotels and inns. Dozens of visitors bring horses to ride on designated horse trails, and hundreds rent horses every week from commercial stables.

Water sports include kayaking, canoeing, boating, and swimming. The majority of paddle crafts use Tomales Bay as it provides protection from ocean waves and surf, while power boaters more freely use the ocean. Though Stinson Beach and Bolinas attract more surfers, North Beach is known as a challenging surfing area. Nature study and wildlife viewing are important activities at Point Reyes. Visitors make special trips to PRNS to see migrating whales, shorebirds, breeding elephant seals, tule elk, and spring wildflowers. Information received from visitor surveys conducted by Sonoma State University (NPS, 1997 and NPS, 1998) found that most park visitors spend 2-6 hours at PRNS in a variety of activities dependent upon the season, ranging from whale watching and kayaking to hiking and bird watching.

The NPS gathers standardized annual surveys for each park unit to determine the percent of visitor satisfaction based on park facilities, visitor services, and recreational opportunities. During Fiscal Year 2002, based on a random visitor survey conducted by the University of Idaho, the park received a 98% visitor satisfaction ranking (NPS, 2002a).

Prescribed burning would have minor positive effects by opening and restoring scenic vistas in all alternatives, but varying adverse effects on some visitor activities from blackening of vegetation from prescribed fires. In Alternatives A and B, this adverse effect would be minor, but because more acreage would be treated with prescribed fire in Alternative C, the impact may be more moderate. Smoke and closures would also have temporary minor adverse impacts on visitors in Alternatives A and B, but may extend to up to 50 days out of the year to complete burning in Alternative C, a moderate adverse impact.

Mechanical treatment may adversely affect nearby visitors through noise and closures. In Alternatives A and B, these impacts would be minor. However, because closures would be more extensive in Alternative C, impacts would be moderate. Changes in the treated area resulting from mowing or hand cutting would be adverse for some visitors, but beneficial for others. Pile burning may also cause localized changes that some visitors find to be negative and others positive. Overall, impacts from mechanical treatment would be short-term and minor in Alternatives A and B, and moderate in Alternative C, regardless of whether they are adverse or beneficial.

Actions to suppress wildfire have the potential to have short-term effects on visual resources, in the form of evidence of helispots and spike camps. These effects would be local in scale and probably not be encountered by most visitors. Effects would be adverse, short-term, and minor in all three alternatives.

Providing information to the public to increase understanding of the objectives of the fire program would be indirectly beneficial, minor, and long-term in any alternative.

The relocation of the fire cache would have short-term adverse impacts to visitors from noise and dust associated with construction.

While construction projects or past fire management activities would have no more than minor short-term cumulative impacts to visitors, a large-scale wildfire could result in major adverse impacts to recreational activities or scenic quality for several years in any of the alternatives.

Park Operations

The park currently has about 90 permanent staff, 23 term employees, and 47 temporary staff working on a variety of projects and programs. This represents about 115 FTE (full time equivalents or one person for a full year). During the peak summer months, the park staff increases to about 160 staff members, including Youth Conservation Corps enrollees who provide assistance in a number of ways to Point Reyes National Seashore. This work force is supplemented by 20,000 hours of Volunteers-in-Parks service, three Student Conservation Assistants, and AmeriCorps.

The Fire Management Office is staffed by a Fire Management Officer, a program analyst, a hazardous fuels specialist, an eight-person hazard fuels crew, one engine foreman, and a four-person engine crew. Three fire staff members are also trained as emergency medical technicians at the basic life support level. Providing technical assistance to both the fire management offices at PRNS and GGNRA are technical staff including a GIS technical specialist, an education specialist, and an environmental planner. PRNS, GGNRA, and Pinnacles National Monument share a fire ecologist and a team of five fire effects monitors. PRNS has mutual aid agreements with Marin County Fire Department, Bolinas Fire Protection District, Inverness Public Utility District, and Nicasio Volunteer Fire Department. While PRNS has direct protection authority for federal lands, Marin County has been given “delegated initial attack responsibility” for these same lands. This allows Marin County to assume authority of initial suppression actions until Seashore firefighters arrive.

Financial resources available to achieve the park’s annual goals include a base operating budget of approximately $4,900,000. In addition, the park receives supplemental support for fire operations, cyclic maintenance, special natural resource projects, and repair and rehabilitation of structures. Fire funding for operations is approximately $770,000 annually for wildfire suppression, mechanical treatments, and prescribed fire. For the last three years, Point Reyes and GGNRA have received an additional $700,000 annually for Wildland Urban Interface (WUI) projects. Staffing for all aspects for fire management is approximately 13 FTE’s.

Because funding and staffing levels would remain the same for all aspects of the fire management program, no positive or adverse impacts to either are expected from No Action. Small increases in budget in Alternative B to conduct additional prescribed burning and thinning would have minor adverse impacts to park operations and management compared to Alternative A. This alternative would require $211,000 in annual operating funds, a 3.8% increase to overall park funding. An overall 5.9% increase in budget and additional 5 FTEs in staffing in Alternative C to conduct additional prescribed burning and thinning would have minor adverse impacts to park operations and management compared to Alternative A.

The one time funding of a new fire cache would have a short-term negligible adverse impact to the park's budget, but would have long-term minor benefits in terms of fire management operations by creating new efficiencies.

Ongoing past, present, and future development and resource management projects in the park would have a negligible adverse effect on park operations and management. However, suppression of a large-scale wildfire would result in a short-term adverse major effect on park operations, management, and budget. This is true for any of the alternatives.

The cumulative impacts of all the projects listed with this proposed action (except large-scale wildfire) would have a negligible adverse effect on park operations and management. Suppression of a large-scale wildfire would a short-term adverse major effect on park operations, management, and budget.

Public Health and Safety

The protection of public and firefighter safety is the most important goal of the PRNS fire management plan, and many of the actions in each alternative are geared to provide the most safe and defensible environment possible. In addition, several of the communities in the vicinity, including Inverness, Bolinas, and Olema, were recently published in the Federal Register as key communities at risk from wildfire because of their proximity to forested federal lands managed by the Departments of Agriculture and Interior. In recognition of potential risk, the National Park Service, through the Wildland Urban Interface (WUI) Program, has been funding fire education, fuel reduction, and roadway improvement projects in these communities; 2002 is the third year of local National Fire Plan funding.

Prioritization of projects needed in the wildland urban interface has been informed by a study of strategies for rehabilitating the resources in the Vision Fire burn area and preventing future similar occurrences. Prepared for the Environmental Action Committee of West Marin, "After the Vision Fire," prepared by the Phoenix Team, documented many of the projects that have subsequently been funded and implemented on private and federal lands with Wildland Urban Interface funding.

The EAC Phoenix Report (1996) recognizes that the most fundamental line of defense to increase public safety is to promote conformance with code requirements for defensible space and reduced fuels around homes and along streets providing emergency ingress and egress.

The WUI program money has been used by the park and other agencies to clear fuel or thin brush from subdivision roads, as well as to complete fire hazard assessments. The next round will focus on creating fuel breaks between open space lands and residential areas. Actions in this FMP in the Inverness Ridge, Limantour, Palomarin, and Olema FMUs would improve safety to responding firefighters, reduce fuels along existing fire roads, and create zones of reduced fuels to impede fire spread.

The principal effect of FMP activities on public health is generation of smoke, especially particulate matter, from prescribed fires and unintended wildland fire. Particulate matter, found in the air-liquid droplets and small solid particles of minerals and soot, can penetrate deep into the lungs. In smoke, roughly 80% of the particulate matter is smaller than 2.5 micrometers in diameter.

Healthy adults are not usually at risk from particulate matter; they may experience runny noses and coughing but these symptoms usually subside as the smoke disperses. People with heart or lung diseases, such as congestive heart disease, chronic obstructive pulmonary disease, emphysema, or asthma, can be at risk. People with these conditions may find it difficult to breathe, may cough or feel short of breath. Children and the elderly are generally more susceptible to the harmful effects of smoke (CARB, 2003).

The actions in all alternatives would have direct adverse, short-term and minor impacts upon the health and safety of both the public and firefighters, except during large, high severity fire events, when the proximity of people to smoke and flame would result in major, short-term, and unavoidable adverse impacts.

Alternative A minimizes smoke impacts in the short-term, but offers no more than negligible benefits in addressing the continued accumulation of fuels that is a wildfire risk to adjacent communities. These benefits would increase to moderate and long-term in Alternatives B and C from the reduction of fuels through both prescribed fire and mechanical thinning and reduction in the risk of catastrophic fire would occur.

Public education, fire research, and fire cache construction would provide minor benefits by informing the public of prescribed burns and by reducing response time and increasing response effectiveness.

Socioeconomics

Point Reyes National Seashore received 2.35 million visitors in 2000 accounting for 930 travel party days/nights in the area. An average visitor party spends $94 per party per night in the local area ($109 if locals excluded). Total visitor spending was $87 million in 2000, $80 million excluding local visitors. This spending of visitors from outside the local region generates $69 million in sales by local tourism businesses, yielding $25.6 million in direct income and supporting 1,100 jobs. Each dollar of tourism spending yields another $.63 in sales through the circulation of spending within the local economy. Including these secondary effects, the total economic impact of the park on the local economy is $113 million in sales, $42 million in wages and salaries, and 1,800 jobs (Michigan State University, 2001).

The park has not received complaints from visitors during past prescribed fires in the park (pers. comm. Neubacher, 2003). Park visitation dropped dramatically for the first few months after the 1995 Vision Fire, but returned to normal within six months.

Under all alternatives, direct fire funding and staffing would have long-term, beneficial impacts compared to dollars and staff positions generated from tourism in the local economy. These benefits would be minor in Alternatives A and B, and moderate in Alternative C.

In any alternative, the prescribed burn program is not expected to result in more than very short-term closures of small areas, with no or negligible adverse impacts on tourism and the local economy. Areas may be closed during mechanical treatment, which because it lasts longer, may result in negligible to minor short-term impacts to tourism and the local economy.

In past years, average sized unplanned ignitions have not impacted the regional economy or the visitor population of the park. However, there have been short-term, negligible impacts to the local economy due to minor closures of areas during suppression for short periods (less than one day). This would continue under any of the alternatives.

Additional building and other projects in the Seashore would have a minor beneficial cumulative effect on the local economy. Cumulative effects from a larger wildfire, should it occur, could be major and both adverse and beneficial. Adverse impacts would result from the loss of property and money spent to suppress the fire, but benefits would also result from rebuilding and the influx of federal money.

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CHAPTER 1: PURPOSE OF AND NEED FOR ACTION

INTRODUCTION

This Final Environmental Impact Statement (FEIS) has been prepared to assist the public and the National Park Service (NPS) in the development of a Fire Management Plan (FMP) for Point Reyes National Seashore (PRNS). The FEIS has been prepared in accordance with the 1969 National Environmental Policy Act (NEPA), which requires federal agencies to evaluate the potential impacts of their actions on the environment. As required by NEPA, the FEIS analyzes several alternatives that could meet the park's objectives for fire management and presents a comparison of the probable impacts of implementing the alternatives.

The planning area for the Fire Management Plan (FMP) includes NPS lands located approximately 40 miles northwest of San Francisco in Marin County, California (Figures 1 and 2). These lands include the 70,046-acre Point Reyes National Seashore (PRNS or the Seashore), which is comprised primarily of beaches, coastal headlands, extensive freshwater and estuarine wetlands, marine terraces, and forests; as well as 18,000 acres of the Northern District of Golden Gate National Recreation Area (GGNRA), which primarily support annual grassland, coastal scrub, and Douglas-fir and coast redwood forests. Under a joint working agreement with GGNRA, the Seashore performs day-to-day management of these nearby GGNRA lands, as well as participating in some planning.

Point Reyes National Seashore was created on September 13, 1962 to "save and preserve for purposes of public recreation, benefit, and inspiration, a portion of the diminishing seashore of the United States that remains undeveloped (Public Law 87-657)." The park is a coastal sanctuary with an exceptionally diverse variety of habitat types - roughly 20% of California's plant species and 45% of North America's bird species have been recorded within its boundaries. The Seashore contains numerous sites indicating Native American occupancy, as well as cultural resources from early periods of European settlement. To preserve the historic ranching legacy of the area, approximately 30 ranches and dairies within Seashore boundaries are under permit agreements with the federal government.

Golden Gate National Recreation Area was created in 1972 "to preserve for public use and enjoyment certain areas…possessing outstanding natural, historic, scenic, and recreational values, and … to provide for the maintenance of needed recreational open space necessary to urban environment and planning." In the management of the recreation area, the NPS shall "preserve the recreation area, as far as possible, in its natural setting, and protect it from development and uses which would destroy the scenic beauty and natural character of the area"(16 USC §460bb).

Figure 1. Project Area- Point Reyes National Seashore and North District of Golden Gate National Recreation Area

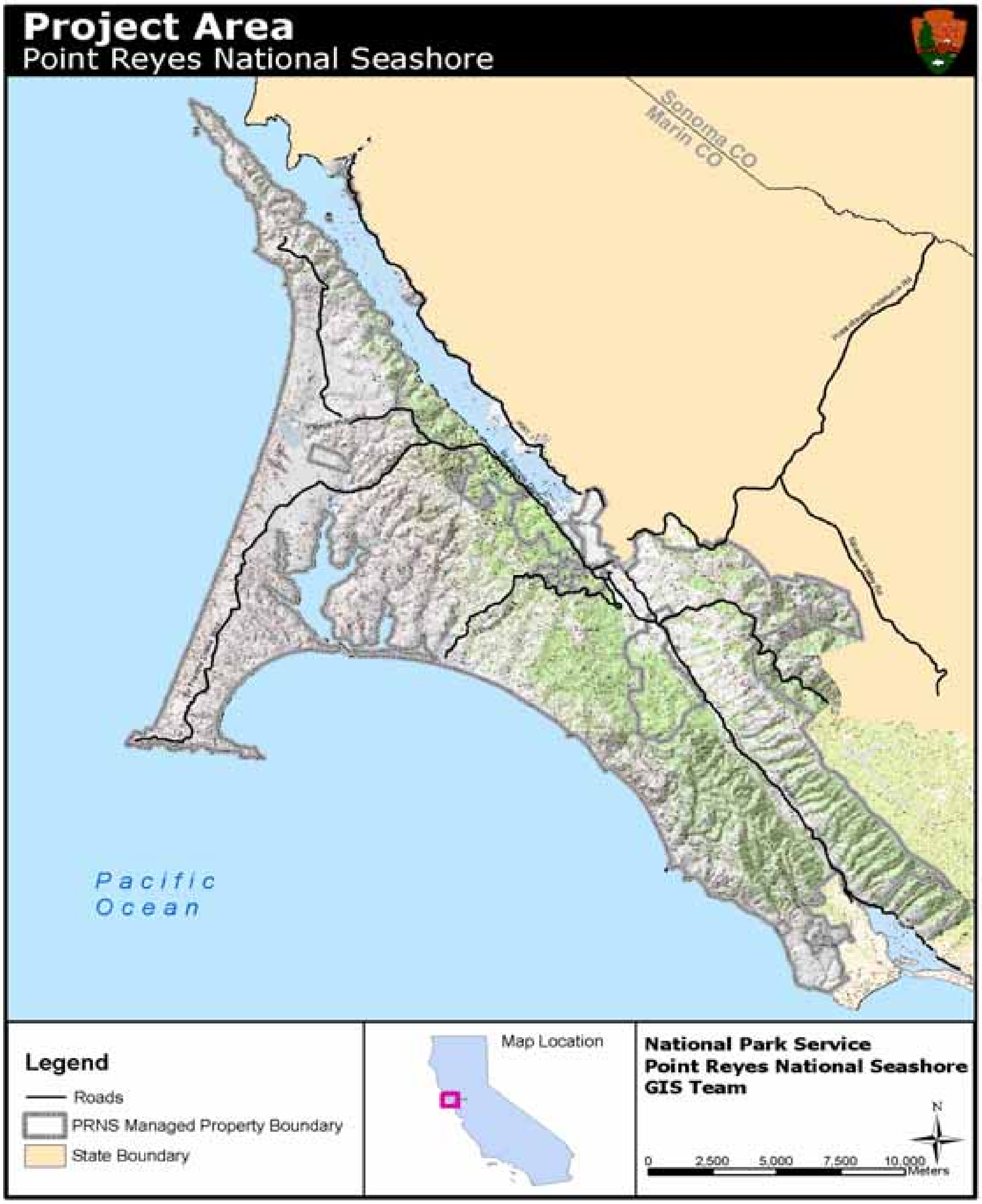


Figure 2. Regional Context Map

Purpose of the Fire Management Plan

The purpose of the Fire Management Plan is to provide a framework for all fire management activities for the Seashore and the North District of GGNRA, including suppression of unplanned ignitions, prescribed fire, and mechanical fuels treatments. It is intended to guide the fire management program for approximately the next 10-15 years. The plan would include concise program objectives, details on staffing and equipment, and comprehensive information, guidelines, and protocols relating to the management of unplanned wildfire, prescribed burning, and mechanical fuels treatment.

Need for the Fire Management Plan

Fire management is an essential component of NPS operations in PRNS and the Northern District lands of GGNRA. The need for a well-planned and effective fire management program is threefold. First, the project area's ecosystems have evolved through time with periodic fire, both natural and human-ignited, and many components of these systems require the continuation of periodic fire. As is typical of many national parks and other federal lands, however, active and effective fire suppression efforts for the past 150 years have dramatically changed native ecosystems. Ecosystem changes from the lack of fire include forest and shrub encroachment on grasslands, decadence and death of fire-adapted species, and extremely dense forests.

Second, fire suppression has also resulted in a dangerous accumulation of flammable or hazardous fuels - large quantities of dead and downed trees and branches that have accumulated in overly dense forests and shrublands. Because of these high fuel loads, residences and businesses adjacent to the Seashore and GGNRA are at risk from catastrophic wildfire or a smaller fire spreading from adjacent parklands. Also, a structural fire close to the park could spread into federal lands and develop into a wildland fire that damages park resources.

Third, the park's existing Fire Management Plan (NPS, 1993) needs to be updated. Since the current FMP 1993 was published, the national fire policies have been updated and new guidelines have been issued to park units. In addition, the NPS has conducted fire research and now has a better understanding of the role of fire in ecosystem preservation, resulting in a greater capability of the PRNS to effectively conduct an effective fire program.

This updated Plan recognizes that a more concerted effort is needed to effectively reduce fire risk along the wildland/urban interface, to reduce hazardous fuels, and to reestablish fire in park ecosystems where it is safe to do so.

Fire Management Plan Goals

The following goals have been developed for the updated Fire Management Plan for PRNS and the Northern District lands of GGNRA. These goals were generated from internal staff meetings and public external scoping meetings and presentations, from review of NPS Policies, Directors Orders, and other fire-related guidance documents listed below.

Goal 1: Protect firefighters and the public.

Goal 2: Protect private and public property.
Goal 3: Maintain or improve conditions of natural resources and protect these resources from adverse impacts of wildland fire and fire management practices.
Goal 4: Maximize efforts to protect cultural resources from adverse effects of wildland fire and fire management practices.
Goal 5: Foster and maintain effective community and interagency fire management partnerships.
Goal 6: Foster a high degree of understanding of fire and fuels management among park employees, neighbors, and visitors.
Goal 7: Improve knowledge and understanding of fire through research and monitoring and continue to refine fire management practices.

Legislative and Policy Constraints and other Considerations used in Developing the Fire Management Plan

The NPS is constrained from taking any actions that might go against relevant laws, regulations, or policies. These include enabling legislation for the NPS, the PRNS, and the GGNRA, NPS Management Policies (revised in 2000), Director's Orders 12 (regulations for implementing the National Environmental Policy Act), Director's Order 18 (regulations for Fire Management Programs), and the PRNS and GGNRA General Management Plan, Resource Management Plan, and other guidance from PRNS planning and policy documents. Other constraints also exist, such as funding limits, staff time, permit availability, resource impacts, burn window, etc. These are briefly explained below.

National Park Service Legislation
Act of August 25, 1916 (National Park Service Organic Act, PL 64-235, 16 USC §1 et seq. As amended). On August 15, 1916, Congress created the National Park Service with the National Park Service Organic Act. This act, as reaffirmed and amended in 1970 and 1978, establishes a broad framework of policy for the administration of national parks:

"The Service thus established shall promote and regulate the use of the Federal areas known as National Parks, Monuments, and Reservations… by such means and measures as to conform to the fundamental purpose of the said Parks, Monuments, and Reservations, which purpose is to conserve the scenery and the natural and historic objects and the wild life therein and to provide for the enjoyment of the same in such manner and by such means as will leave them unimpaired for the enjoyment of future generations."

Specific Park Legislation
Congress established Point Reyes National Seashore on September 13, 1962 "to save and preserve, for purposes of public recreation, benefit and inspiration, a portion of the diminishing seashore of the United States that remains undeveloped (Public Law 87-657)." An amendment to Public Law 94-544 (passed in 1976) states that the Seashore is to be administered without impairment of its natural values.

Congress established Golden Gate National Recreation Area by Public Law 92-589 "in order to preserve for public use and enjoyment certain areas of Marin and San Francisco Counties, California (San Mateo County added by P.L. #96-607).” In addition to providing for recreation and educational opportunities consistent with sound principles of land use planning and management, the NPS was also instructed to “preserve the recreation area, as far as possible, in its natural setting, and protect it from development and uses which would destroy the scenic beauty and natural character of the area.”

Wilderness Act (16 USC 1133)
All actions undertaken in the wilderness, including suppression of wildfires and other aspects of fire management, must conform to the “minimum requirement” concept, and be conducted in such a way as to protect natural and cultural resources (NPS, 2000, 6.3.9). The minimum requirement concept is a two-step documented process that determines:

> 1. whether the action is appropriate or necessary to administer the area as wilderness and does not pose a significant impact to wilderness resources and character, and 2. which techniques or types of equipment are needed to ensure minimum impact to wilderness resources and character (NPS, 2000, Sec. 6.3.5).

Endangered Species Act of 1973, as amended (PL 93-205, 87 Stat. 884, 16 USC §1531 et seq.)
The Endangered Species Act protects threatened and endangered species, as listed by the U.S. Fish and Wildlife Service, from unauthorized take, and directs federal agencies to ensure that their actions do not jeopardize the continued existence of such species. Section 7 of the act defines federal agency responsibilities for consultation with the U.S. Fish and Wildlife Service and requires preparation of a Biological Assessment to identify any threatened or endangered species that is likely to be affected by the proposed action. The National Park Service initiated and maintains informal consultation with the U.S. Fish and Wildlife Service regarding this FEIS.

Wildland Fire Management Policy
The NPS has made fire and fuels management a very high priority national issue. In 2001 the Interagency Federal Wildland Fire Policy Review Working Group revised the Federal Wildland Fire Management Policy, which applies to all federal land management agencies. The key element of the policy is that firefighter and public safety is the first priority. In addition, the policy states that fire, as a critical natural process, will be integrated into land and resource management plans and activities on a landscape scale, and across agency boundaries. The policy also directs that fire management plans and programs will be based on a foundation of sound science. Research will support ongoing efforts to increase our scientific knowledge of biological, physical, and sociological factors.

The National Park Service Management Policies
NPS Management Policies (NPS, 2000) is the basic Service-wide policy document of the NPS. These policies provide guidance in the development of an updated Fire Management Plan. The following elements related to fire management are important considerations.

Each park with vegetation capable of burning will prepare a fire management plan and will address the need for adequate funding and staffing to support its fire management program. The plan will be designed to guide a program that responds to the park’s natural and cultural resource objectives; provides for safety considerations for park visitors, employees, neighbors, and developed facilities; and addresses potential impacts to public and private property adjacent to the park.

Parks will use methods of wildland fire suppression that not only minimize impacts of both the suppression action and of the fire; but also are commensurate with the goals of maintaining effective control, working to ensure firefighter and public safety, and protecting valuable resources.

Technical or Logistic Constraints

The approximate weather window for prescribed burns at Point Reyes is from June to November. Burning can begin in the Olema Valley after annual grasses have cured, which does not normally occur until mid-June to early July. While the burn window in the Olema Valley is generally the most flexible in the Seashore, burns must be timed to fall between the dissipation of the coastal fog and the onset of afternoon sea breezes.

During the summer months coastal fog normally keeps fuels moist on Inverness Ridge and to the west. Burning on Inverness Ridge and in coastal areas can be extremely difficult. This is because there is a narrow burning window from late September to early October when fuels dry out. East wind events during this same time frame can result in Red-Flag Days on which no burning is allowed.

Smoke can have local impacts on residents of West Marin and can impair road visibility. All burns meeting resource management objectives must be submitted to the Bay Area Air Quality Management District (BAAQMD) for a permit. Often, "burn days" do not coincide with weather conditions appropriate for burning in PRNS.

Constraints Imposed by Risk

PRNS is one of three NPS units in this region that has been identified as having a wildland/urban interface at risk from a potential fire on NPS land. There are four communities bordering the Seashore that meet the criteria for communities at risk from wildfire. The NPS Management Policies (NPS, 2000, Sec. 4.5) indicate park units must comprehensively consider firefighter and public safety and costs as well as resource values in deciding appropriate strategic and technical options for managing wildland fires. Because of the existing neighboring urban areas and the potential for wide-spread risk to public safety or property, and because, as noted above, vegetation in the project area tends to grow quickly and burn hot and fast, wildland fire has been excluded as a tool. In other words, all natural or accidental ignitions would be suppressed.

Any time a prescribed burn is executed on Seashore administered lands, there is always a risk to the residents and property of adjacent communities. The high financial and emotional cost of the loss of residential structures is a major concern. PRNS is committed to managing prescribed burns to minimize any risk to private land. The risk of such an escape is always a major factor when making the final decision as to whether to conduct a controlled burn or use mechanical methods to reduce fuels. If controlled burning in the interface and along roads is conducted, it must proceed at a slower pace than in other areas to minimize smoke production.

Because of high values at risk in the interface and smoke concerns, PRNS has adopted a general policy of not allowing fires to burn freely within a perimeter through the night. This requires that all burn perimeters be secure by the end of each day. Burn units must therefore be kept small and larger units must be subdivided into segments that can be burned in one day. This precludes any strategy of large-scale landscape fire restoration at PRNS. Smaller units generally take more time for fewer acres and drive up the cost per acre.

Constraints Imposed by Park Resources or Values

Point Reyes has significant populations of threatened and endangered plant and animal species, and other unique wildlife. These biota can and do affect the time, location and layout of fire management activities. For example, a buffer zone around spotted owl nests is required for a burn to take place and burning is restricted in habitat occupied by mountain beaver. Riparian areas are also avoided and not burned because they provide needed bank vegetation for Coho salmon and steelhead trout, which are federally listed as threatened

Avoiding these sensitive resources can result in burn units that are not optimally laid out for operational defensibility. This means more firefighters are required and that slower, more precise fires result in fewer acres burned.

Staffing Constraints

The NPS has instituted new guidelines for prescribed burning (NPS Reference Manual 18, Chapter 10), which, among other changes, require that all NPS prescribed burns have "contingency resources" (such as fire trucks on stand-by) committed and assigned to every burn. These contingency resources must be available based on the prediction of a worst-case scenario. This is further complicated by the fact that the fire season peaks around the nation in the summer months, and resources that are normally used for conducting prescribed burns may be needed in another location for emergency fire suppression

Relationship to Other Plans

General Management Plan
The General Management Plan/Environmental Analysis, Golden Gate National Recreation Area and Point Reyes National Seashore (NPS, 1980) recognized the need to incorporate prescribed burning into research programs designed to enhance ecosystem management in the park. The Plan states: "Although the majority of the seashore is generally viewed as a wild area where natural processes are allowed to predominate, manipulation of those processes through methods such as selective thinning, burning and mowing will be cautiously pursued when necessary to protect its scenic, ecological and recreational values (NPS, 1980)."

Point Reyes National Seashore Strategic Plan
The PRNS Strategic Plan states that by 2003, the application of fire as a natural environmental variable will be incorporated to the fullest extent practicable in resource management and that fire management personnel will attempt to reduce fuels by 25% in strategic areas adjacent to the Seashore's wildland urban interface boundary and within fire management units.

Resources Management Plan
The Resources Management Plan for PRNS (NPS, 1999b) describes goals, objectives and implementation strategies for documentation and long-term protection of cultural and natural resources. Research objectives within the plan regarding fire call for determining the following:

- Fire history of the Seashore
- Effects of fire on abiotic and biotic resources
- Methods for controlling non-native plants using prescribed fire
- Methods for restoring native grasslands using prescribed fire
- Relationship to Plans, Projects, and Activities of Other Agencies

Mount Tamalpais Area Vegetation Management Plan - Marin Municipal Water District (MMWD)
This plan, prepared in 1995, presents strategies for managing vegetation on over 19,000 acres owned by MMWD and an adjacent 1,150 acres owned by Marin County Open Space District (MCOSD). The plan provides specific recommendations for reducing fire hazards and enhancing biodiversity. The plan did not provide specific recommendations regarding the interface between MMWD and GGNRA North District on Bolinas Ridge. However, at this interface, the plan recommends the NPS continue its fuel reduction operations along the top of Bolinas Ridge. This information would be used to guide the development of the updated Fire Management Plan.

Marin County's Fire Plan
The Marin County's Fire Plan: A Wildland Fire Risk Assessment Model (2000) provides a prescription for reducing costs and losses from wildland fire. The plan uses a four-factor assessment that defines Marin County's wildland fire risk and hazards. The plan also addresses generalized wildland fire risk for federal parklands. This information has been be used to guide PRNS in developing strategic fire management units and fire treatments in this Fire Management Plan.

California Fire Plan
In 1996 the California State Board of Forestry and the California Department of Forestry (CDF) and Fire Protection prepared the California Fire Plan (CDF, 1996). The overall goal of the plan is to reduce total costs and losses from wildland fire in California by protecting assets at risk through focused pre-fire management prescriptions and increased initial attack success. Key elements of the plan are the development of wildfire safety zones and cooperation with stakeholders, including federal agencies. General strategies from the plan will be used as the updated Fire Management Plan is developed and implemented.

Marin Countywide Plan
The Environmental Hazards Element of the Marin Countywide Plan (Marin Community Development Agency, 1994) discusses fire hazards and wildfires. Adopted polices encourage fuel breaks, brush clearance, and reduction of hazardous fuels. The Fire Management Plan would incorporate these and other strategies for reduction of fire hazard. In addition, PRNS and the GGNRA North District are part of the Marin County Coastal Recreation Corridor. The Countywide Plan recommends that PRNS and GGNRA be retained in their natural state to the greatest extent possible, and that recreation uses be low intensity. This recommendation is in accordance with the basic principals that guide all NPS planning efforts.

Issues and Concerns Raised During Scoping

During a series of scoping meetings, the NPS requested input from the public, from federal, state, and local agencies, and from park resource specialists on fire management concerns, the types of issues that should be addressed in the FEIS, and the range of fire management alternative strategies that should be considered.

On January 27, 2000, a "Notice of Scoping for Fire Management Plan at Point Reyes National Seashore" was published in the Federal Register. On January 29, 2000, at a public meeting of the Point Reyes National Seashore Citizen Advisory Commission, a presentation was given announcing the scoping period for the plan. Scoping comments were solicited from January 27, 2000 to March 28, 2000.

In addition to the Federal Register Notice, the scoping period was publicized through a mass mailing to the public that included background information on the FMP and a notice of a scoping workshop held March 9, 2000. The workshop was also advertised through notices posted in the communities surrounding the park and a notice in the local weekly newspaper, the Point Reyes Light. The two-hour March 9 public scoping workshop was attended by five citizens.

On February 14, 2000 and on February 22, 2000, internal scoping sessions were conducted to identify staff issues and concerns. These meetings were attended by an interdisciplinary group of resource and fire specialists from the PRNS and GGNRA staff.

On March 28, 2000, a two-hour scoping session was held for local fire agencies. In addition to representatives of the NPS Fire Management Office, members of the Marin County Fire Department, Inverness Volunteer Fire Department, California State Parks, and Marin Municipal Water District were in attendance. Also invited, but not attending, were the Marin County Open Space District, Bolinas Fire Protection District, Nicasio Volunteer Fire Department, and Stinson Beach Fire Department.

The issues and concerns identified during scoping and from earlier public comments fell into 14 main areas, ranging from air and water quality to biological and cultural resources, visitor experience, and human health and safety. These issues and concerns provided the basis for the selection of the "impact topics" that will be addressed in the environmental consequences section of this FEIS. They are discussed briefly below.

Soils
Wildland fire suppression activities, prescribed burns, and fuel reduction by mechanical means could remove vegetation from the soil surface, resulting in loss of topsoil to erosion. In areas that burn with high intensity, soils can become hydrophobic (i.e., water repellant), and suffer a decrease in soil productivity by destroying soil microorganisms or by volatilizing stored nitrogen and other essential nutrients.

Air Resources
PRNS is a Class I air quality area under the federal Clean Air Act. Class I areas carry the most stringent standards for pollution concentrations. Wildland fire releases pollutants that contribute to a degradation of local air quality and could contribute to a long-term decline of air basin air quality. Extremely small particles, less than 10 microns in size, can be generated by burning and ground-disturbing activities. These particles have been associated with health problems.

Hydrology, Water Resources, and Water Quality
Fuel reduction actions such as prescribed burning or brush clearing remove vegetation and disturb soils. This disturbance can result in soil erosion, increased sedimentation in nearby water bodies, and increased water turbidity. The use of off-road vehicles during wildland fire suppression can alter surface drainage patterns. Deposits of sediments can also increase the occurrence or severity of localized flooding and cause changes in surface hydrology.

Vegetation
Vegetation within the project area could be subject either to adverse or beneficial effects as a result of fire management activities. For example, pile burning of downed vegetation, poorly executed prescribed burns, and catastrophic wildland fires can create very hot, severe conditions that kill above ground biomass, as well as seeds in the soil, which can alter revegetation and successional patterns. During wildland fire suppression, the construction of control lines and firebreaks, the creation of access roads, and other activities such as "mopping up" can destroy or damage native vegetation. Fuel reduction methods such as scraping, mowing, or brush cutting, which are designed to eliminate non-native vegetation or to thin dense vegetation, can also destroy or damage native plant species. Both fires and mechanical treatments can increase the potential for invasion or spread of non-native plant species, many of which successfully out-compete native vegetation as the cleared area is revegetated. Alternatively, wildland or prescribed fire can benefit some plants and plant communities by creating a mosaic of successional states that will support greater species richness. Some species in the project area may be highly dependent on fire for their long-term reproductive success (e.g., Bishop pine, Marin manzanita).

Wetlands
Wetlands are lands that are transitional between terrestrial and aquatic systems, where the water table is usually at or near the surface or the land is covered by shallow water. Perennial and seasonal wetlands burn only occasionally in late summer and fall under dry conditions. Wetlands could be affected by fire suppression activities such as fire line creation, mowing, or the use of heavy vehicles in soft soils. High fire intensity could alter wetland soils, vegetation, or hydrology. Extremely hot fires, for example, can kill large areas of vegetation and allow non-native species to vegetate the area.

Wildlife
The project area supports an exceptional diversity of wildlife species, which could either benefit from or be harmed by fire management activities. Wildlife could be killed or harmed by wildland fire, prescribed burns, or mechanical treatments such as mowing. Species could be affected by changes in vegetation structure or composition resulting from fire or mechanical treatments. For example, some species are dependent on moist habitats and would be displaced if the canopy layer were removed. Fire and mechanical removal of fuels, however, usually results in greater habitat heterogeneity (i.e., a mosaic of different habitat types) that can increase or maintain wildlife species richness.

Special-Status Species
The project area is home to numerous plant and wildlife species that are globally, nationally, regionally, or locally rare. Examples of federally listed species in the project area are the northern spotted owl, coho salmon, steelhead trout, Myrtle's silverspot butterfly, Point Reyes mountain beaver, California red-legged frog, and Sonoma spineflower.

Fire management activities have the potential to affect many of these species. For example, coho salmon and steelhead trout could be affected by increased sedimentation in creeks and/or persistent turbidity following wildland or prescribed fire. Conversely, as is the case for common plants and wildlife, many special-status species in the project area are adapted to periodic fire, and application of fire to the ecosystems could benefit these species by providing a wider diversity of habitats, by stimulating seed germination, or by improving habitat for prey species.

Cultural Resources
Fire management activities, including fire suppression or fuels treatments, could result in impacts to prehistoric and historic cultural resources in the park. A hot wildfire could damage historic or prehistoric surface material. Conversely, a prescribed burn could enhance a culturally significant landscape by perpetuating an important historic scene. The project area contains important archeological and historically significant sites, as well as cultural landscapes that could experience impacts from these actions.

Visitor Experience
Fire management activities may affect visitor experience by requiring trail closures, or by causing changes to the physical environment and aesthetics of the park setting. PRNS includes the 33,373 acre Phillip Burton Wilderness Area that was Congressionally authorized n 1976. This designated wilderness area preserves a critical remnant of undeveloped California coast. Fire suppression actions and fire management projects may temporarily affect the wilderness qualities protected in this area, such as isolation, opportunities for solitude, and natural quiet. In the long-term, fuel reduction actions and prescribed burns have the potential to change both the visual appearance and the viewsheds of the park.

NPS Management and Operations
Each of the proposed alternatives may affect park staff and budgets differently, and budgetary constraints could reduce the ability of the park to implement each objective. The FEIS addresses the impacts of each fire management alternative on park operations in terms of staffing,

implementation costs and equipment, and requirements for maintaining effective fuel reduction zones.

Human Health and Safety
Fire management and fire suppression actions can affect the health and safety of firefighters, local residents, and visitors. Weather conditions during prescribed fires could change unexpectedly, resulting in an unanticipated shift in the smoke plume or in an uncontrolled wildfire that could put people or property at risk. Alternatively, reduction of hazardous accumulations of fuels around developed areas through mechanical treatments or prescribed burning will reduce the risk of catastrophic fire, thus having beneficial effects on human health and safety.

Regional Economy (Socioeconomic Issues)
Fire management projects involving prescribed burning or mechanical treatments that impede the use of the park by visitors through short-term road and trail closures could result in a loss of revenue to local businesses which rely on tourism.

Issues Dismissed from Further Consideration

Floodplains
All federal agencies are required to consider the effects of federal actions on floodplains (Executive Order 11988 – Floodplain Management). This Executive Order, however, pertains to the occupancy or modification of floodplains, and to development within floodplains, neither of which would result from implementation of the proposed Fire Management Plan.

Prime and Unique Farmlands
To ensure compliance with the Farmland Protection Policy Act (FPPA; PL 97-98; 7 U.S.C. 4201 et seq.), the Council on Environmental Quality (CEQ) requires consideration of impacts to prime and unique farmland as a result of federal actions. Prime and unique farmlands are defined by the U.S. Department of Agriculture (USDA) and are determined by the USDA Natural Resources Conservation Service (NRCS). Within the project area, Giacomini Ranch is classified as prime or unique. However, because of high year-round moisture levels and low intensity burning fuels in this area, none of the proposed alternatives includes management actions for Giacomini Ranch. Therefore, this issue is not included as an impact topic discussed in the FEIS.

Sacred Sites and Indian Trust Resources
As stated in NPS Management Policies (NPS, 2000), the NPS acknowledges that American Indian tribes treat specific places containing certain natural and cultural resources as sacred places having established religious meaning, and as locales of private ceremonial activities. Fire management activities in the proposed Fire Management Plan would not have any impacts on sacred sites. In addition, there are no Indian Trust resources in PRNS.

Selection of Impact Topics

Selection of topics to be addressed in the FEIS was based on concerns raised during internal and public scoping, and on regulatory and NPS policy requirements. These issues involve significant resources that could be beneficially or adversely affected by project implementation. Impact topics include the following:

- Air Quality
- Water Resources and Water Quality
- Soils
- Vegetation
- Wetlands
- Wildlife
- Special Status Species (e.g., Threatened, Endangered, Rare and Sensitive Species)
- Cultural Resources
- Human Health and Safety
- Visitor Experience and Visual Quality
- NPS Management and Operations
- Regional Economy (Socioeconomic Issues)

CHAPTER 2: ALTERNATIVES - INCLUDING THE PREFERRED ALTERNATIVE

OVERVIEW OF ALTERNATIVES

The following three alternatives have been developed for the Seashore's Fire Management Plan FEIS:

- Alternative A (No Action) - Continued Fuel Reduction for Public Safety and Limited Resource Enhancement
- Alternative B - Expanded Hazardous Fuel Reduction and Additional Natural Resource Enhancement
- Alternative C (Preferred Alternative) - Increased Natural Resource Enhancement and Expanded Hazardous Fuel Reduction

NEPA requires project proponents to identify a range of reasonable alternatives within an EIS. Reasonable alternatives must be economically and technically feasible and demonstrate common sense. Alternatives must meet stated goals and objectives for taking action to a large degree, and must be within identified constraints. The No Action alternative must be analyzed under NEPA requirements. For this FEIS, the No Action alternative represents no change in fire management actions as they have been implemented over the past five years (1997-2001).

Initially, six alternatives were considered during development of this FEIS. Of these, three are fully analyzed in this document. The other three were considered carefully, but rejected because they would not adequately meet the fire program's objectives. These alternatives are briefly discussed in the section Alternatives Considered But Not Analyzed Further in this FEIS at the end of this chapter.

The three alternatives analyzed - Alternatives A, B, and C - meet Seashore goals and objectives to an acceptably large degree, and are within constraints imposed by regulations and policies, by risks associated with the wildland urban interface, and by technical and funding limitations. Although EIS alternatives must meet objectives and resolve planning issues to a large degree, they can vary in their methods, or in the degree to which each objective is met. This is the case in this plan, as some objectives or issues were emphasized in one alternative, and others in another.

All three alternatives involve different combinations of prescribed burning and mechanical treatments. The upper limits for both these management activities in all alternatives are a function of the risk, weather, staff, and funding limitations described in the Constraints Section of Chapter 1. As noted in that section, the use of fire on a landscape scale is not possible in the study area because of these constraints. In each alternative, an upper limit has been set on the number of acres that would be burned or mechanically treated in any one year (Table 1, based on internal scoping with park specialists in several fields. Alternative A (No Action) is based on the average number of acres treated over the past few years at the Seashore.

Table 1. Maximum Number of Acres that would be Treated with Prescribed Fire and Mechanical Treatment in Any One Year Under the Three Alternatives.

Alternative	Maximum Number of Acres		
	Prescribed Burning	Mechanical Treatment	Total
A	500	500	1,000
B	1,000	1,000	2,000
C	2,000	1,500	3,500

Alternative A (No Action - Continued Fuel Reduction for Public Safety and Limited Resource Enhancement) involves the continuation of existing practices as prescribed in the 1993 Fire Management Plan. Existing practices include mechanical hazardous fuels treatments, primarily mowing in grasslands, and limited prescribed burning, primarily for fuel reduction in grasslands and for the control of Scotch and French broom. Current research projects regarding the reduction of Scotch broom and velvet grass through prescribed burning would continue under this alternative.

Alternative B (Expanded Hazardous Fuel Reduction and Additional Natural Resource Enhancement) calls for a substantial increase over present levels in the reduction of hazardous fuels through prescribed burning and mechanical treatments. Efforts would be concentrated in areas where unplanned ignitions are most likely to occur (e.g., road corridors) and where the creation of defensible space would be most effective at containing unplanned ignitions and protecting lives and property (e.g., around structures). Natural resource enhancement would occur as a secondary benefit only. For example, in prescribed burns for fuel reduction along Highway 1, the non-native French broom would be eliminated.

Alternative C (Increased Natural Resource Enhancement and Expanded Hazardous Fuel Reduction) would result in a marked increase in efforts to enhance natural resources. Increasing the abundance and distribution of threatened and endangered species, reducing infestations of invasive, non-native plants, and increasing native plant cover would be particularly emphasized under this alternative. Burning would also be used to protect or enhance cultural resources, such as to reduce vegetation in areas identified as important historic viewscapes.

Alternative C also would include continued reduction of hazardous fuels in high priority areas (e.g., along road corridors and around structures). Under this alternative, research efforts would be expanded to determine the effects of fire on natural resources of concern (e.g., rare and non-native species) and to determine the effectiveness of various fuel treatments. Research results would be used adaptively to guide the fire management program in maximizing benefits to natural resources, while protecting lives and property.

Discussion of Fire Management Units

For planning purposes, the park landscape has been divided into 11 fire management units (FMUs) based on geography, fuels management and habitat enhancement needs, and on values at risk (Figure 6). Ten of these FMUs are units that may be subject to fire management actions (prescribed burning or mechanical fuel reduction treatments). The eleventh FMU - the Minimum Management Unit - includes large areas of the park that would only be subject to vegetation clearing around buildings and along roads, and full suppression of all fires.

These FMUs were developed using Marin County's Fire Plan: A Wildland Fire Risk Assessment Model (MCF, 2000) and fire professional expertise. Many FMUs such as Inverness Ridge, Wilderness North, Wilderness South, Bolinas Ridge, Highway 1, Limantour, and Palomarin are strategically located to primarily treat the highest ranking fuels (secondarily, there are resource enhancement benefits). In the event of a wildland fire, these treated areas would provide a tactical advantage to firefighters. Their treatment with defensible space, fire road clearing for emergency evacuation, and wildland urban interface programs provide a systematic effort to protect life and property. Other FMUs such as Tomales Point, Estero, and Headlands have been established primarily for resource management reasons. Three graphics – Fuel Ranking Map, Potential Living Unit Loss, and Resistance to Control (Figures 3, 4, and 5, respectively) - illustrate one aspect of the background behind establishment of the proposed FMU locations. These fire assessments, along with feasibility of access, potential for beneficial and adverse resource impacts, and the advice of fire professionals were used to develop the FMUs.

Figure 3. Fuel Ranking Map Measuring Risk of Wildland Fire

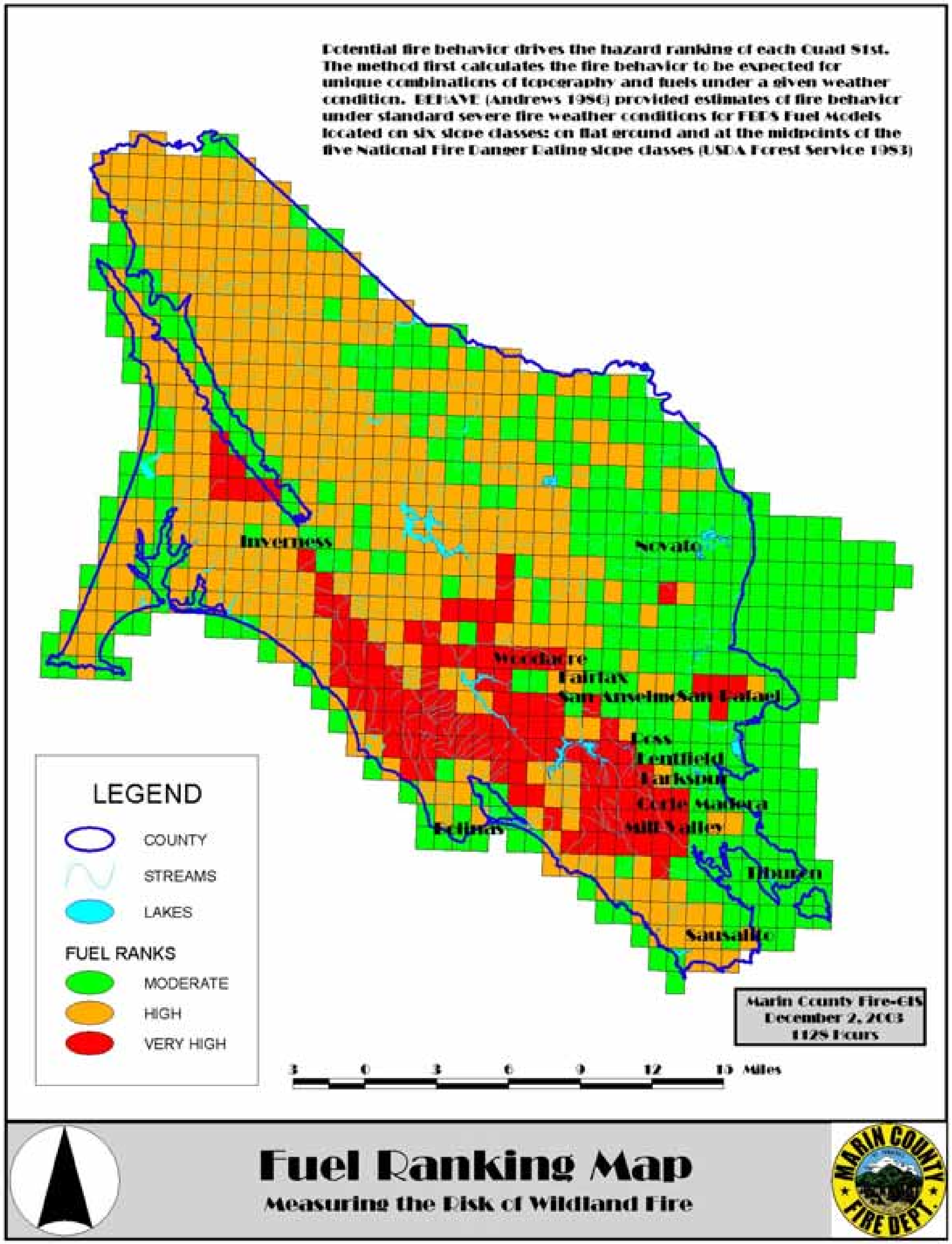


Figure 4. Potential Living Unit Loss Measuring the Risk of Wildland Fire

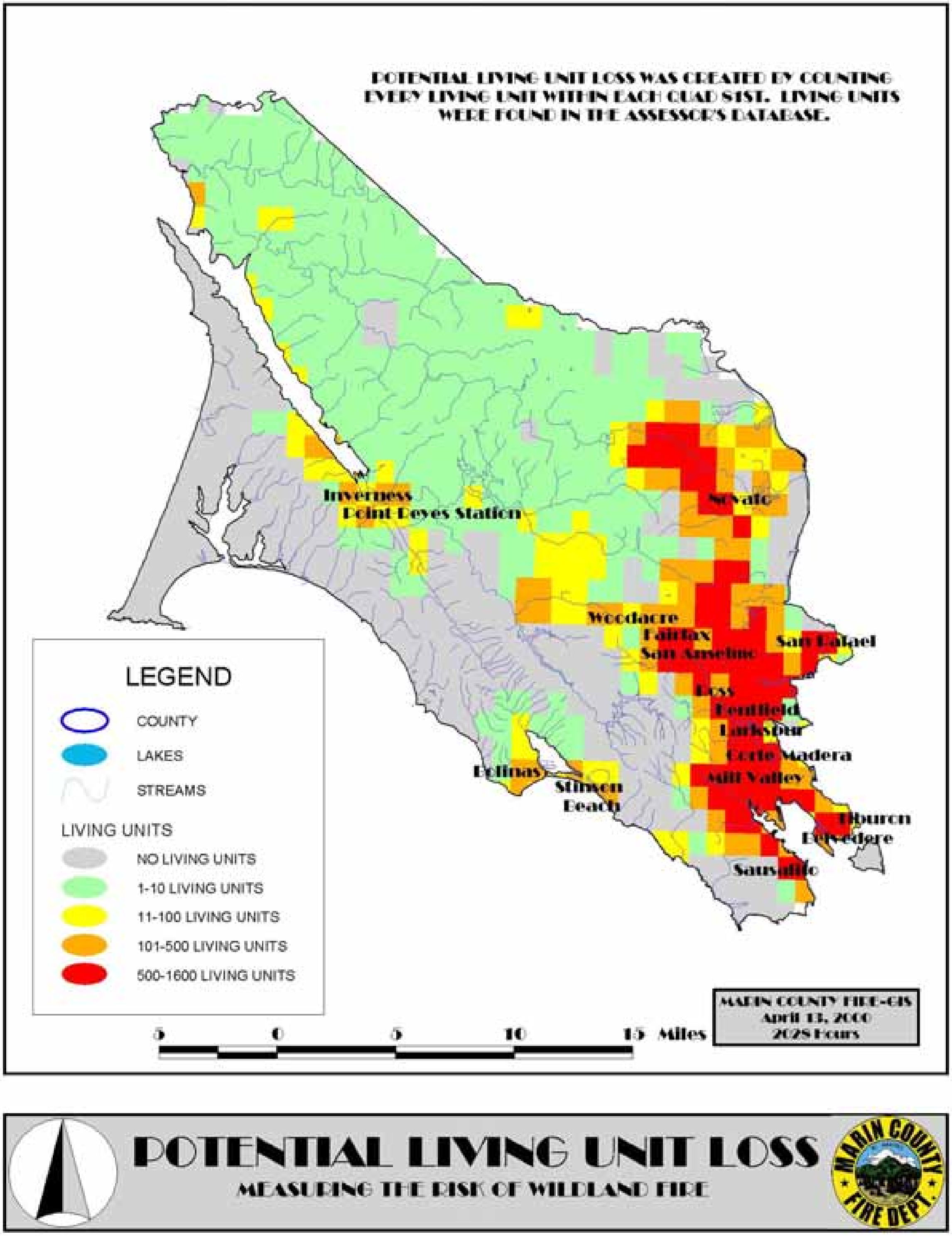


Figure 5. Resistance of Control Measuring the Risk of Wildland Fire

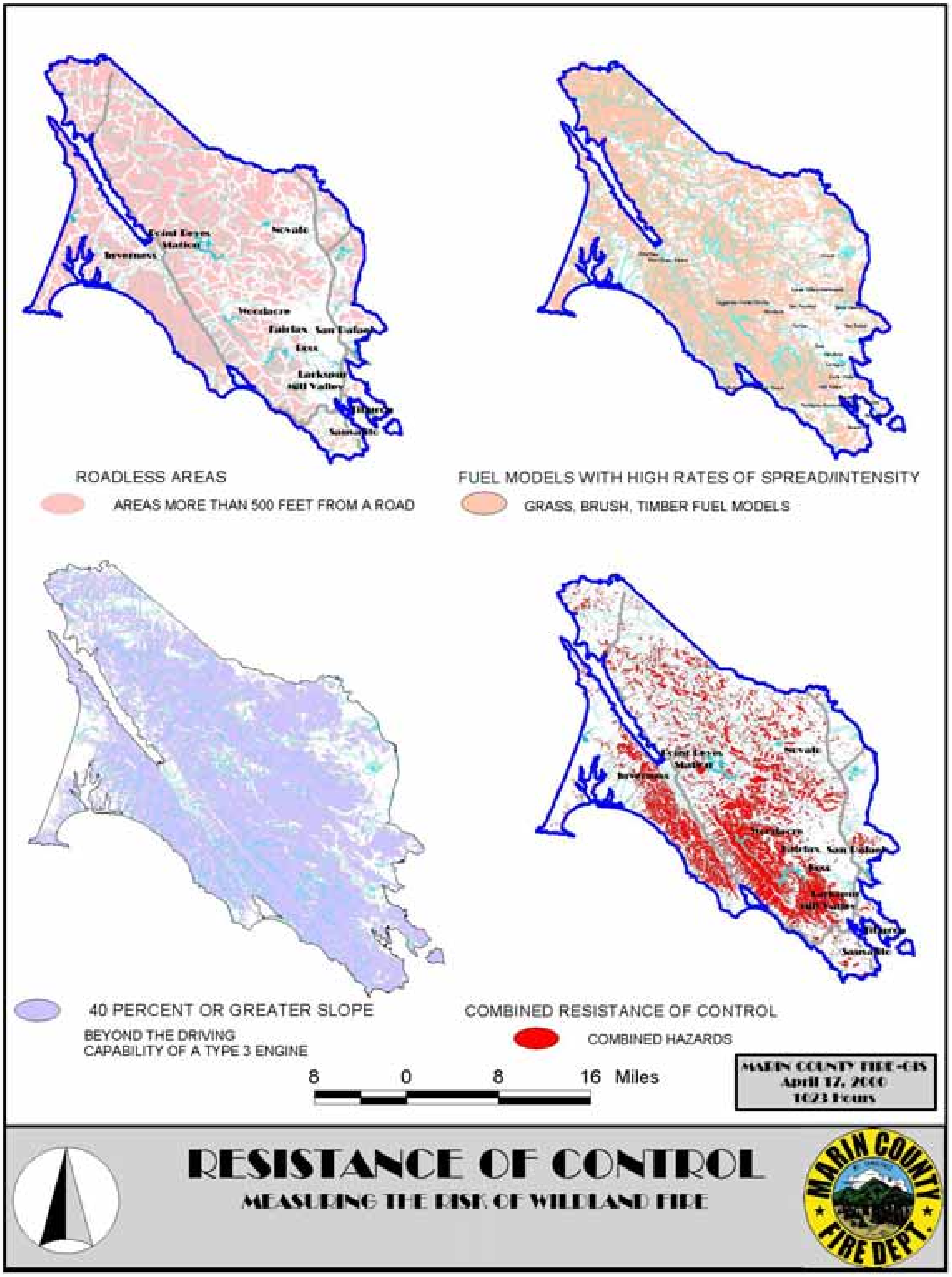
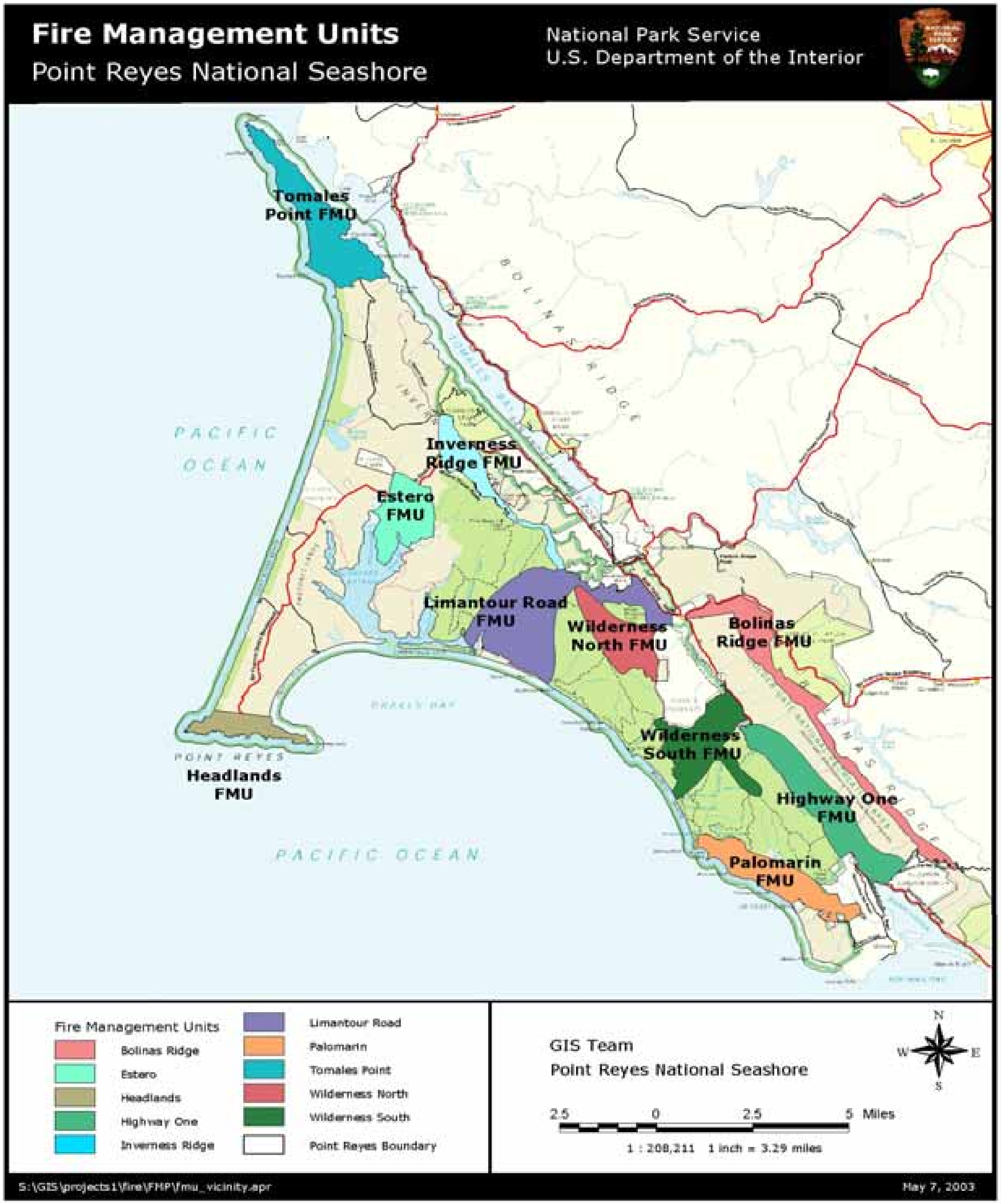


Figure 6. Map of Project Area Showing All Fire Management Units



Each FMU is addressed in the discussions of the three alternatives in this FEIS, but not all alternatives include management actions within each unit. Table 2 illustrates which FMUs could be subject to prescribed burning or mechanical fuels treatments under each alternative. Brief descriptions of the FMUs follow Table 2.

Table 2. Fire Management Units That Would Be Subject To Treatment Beyond Clearing Around Buildings Of Fire Roads And Trails (Prescribed Fire, Mechanical Treatment Or Both) Under Each Alternative.

Fire Management Unit	Alternative A		Alternative B		Alternative C	
	PF[1]	MT[2]	PF	MT	PF	MT
Tomales Point				X	X	X
Headlands					X	
Estero	X	X	X	X	X	X
Inverness Ridge			X	X	X	X
Limantour Road	X	X	X	X	X	X
Wilderness North			X	X	X	X
Wilderness South			X	X	X	X
Highway One	X	X	X	X	X	X
Bolinas Ridge	X		X		X	
Palomarin			X	X	X	X
Minimum Management[3]						

[1]Prescribed Fire
[2]Mechanical Treatment
[3] No treatments to occur except clearing of fire roads and removal of vegetation around buildings.

TOMALES POINT (2,781 acres) - This unit encompasses all of the land on Tomales Point north of a fence from Tomales Bay to the Pacific Ocean (in place to create a tule elk reserve.) It supports grassland, mixed coyote brush scrub, and dense bush lupine stands at the northern tip of the peninsula. In 1978, tule elk were reintroduced to Tomales Point, and the present herd size is approximately 450 animals. Populations of ten plant species of management concern occur in this FMU; six of these are federal Species of Concern and one, Point Reyes blennosperma (*Blennosperma nanum*), is listed as rare by the state (Table 3). The historic Pierce Ranch Complex, which has grounds that support a variety of associated invasive non-native plants (e.g., eucalyptus, cape-ivy) is within this FMU.

HEADLANDS (881 acres) - The Point Reyes Lighthouse bluffs and Chimney Rock area at the westernmost tip of Point Reyes comprise this FMU. It contains some areas of designated wilderness along the outer bluffs. Vegetation on the unit is dominated by grassland and patches of mixed coyote brush and coastal scrub. This FMU has been subject to intense grazing pressure from cattle in the past, and currently some areas continue to be grazed, while others have been excluded from grazing. Twelve plant species of management concern occur in this FMU (Table 3); five of these are federal Species of Concern, one is state-listed as rare (Point Reyes blennosperma), and one is state-listed as endangered (Point Reyes meadowfoam - *Limnanthes douglasii var. sulphurea*). The Headlands harbor sensitive animal species such as brown pelican and Steller sea lions. Other sensitive animal species include nesting seabirds such as ashy storm-petrel. Marine mammals such as harbor seals are sensitive to human activities including low flying helicopters. Lands within this FMU receive very high levels of visitor use, and are popular for wildflower viewing in the spring.

ESTERO (1,638 acres) - The Estero FMU is located at the northern end of Drakes Estero, along the edges of Schooner and Home bays. This area supports primarily grassland and mixed coyote brush and poison-oak scrub habitats, with patches of wax-myrtle (*Myrica californica*) in seasonal drainages. A stand of Monterey pine occurs in the southeast corner of the FMU. The Seashore has been using prescribed fire and mowing treatments to control the non-native plant Scotch broom (*Cytisus scoparius*) in this FMU since 1993, and plans to continue with these treatments. Populations of Point Reyes mountain beaver occur in shrubby drainages within this unit. This species, although not federally listed, is of concern to Seashore managers as it is a rare species whose populations were significantly reduced by the Vision Fire in 1995. This FMU also supports nine plant species of management concern, five of these are federal Species of Concern (Table 3).

Table 3. Federal, State, and California Native Plant Society (CNPS) Listed Plant Species in each Fire Management Unit.

SPECIES		REGULATORY STATUS		
Common Name	Scientific Name	FEDERAL	STATE	CNPS LIST[1]
Tomales Point FMU				
pink sand-verbena	*Abronia umbellata ssp. breviflora*	Species of Concern	none	1B
coast rock cress	*Arabis blepharophylla*	none	none	4
Point Reyes blennosperma	*Blennosperma nanum var. robustum*	Species of Concern	Rare	1B
coastal bluff morning glory	*Calystegia purpurata ssp. saxicola*	none	none	1B
Franciscan thistle	*Cirsium andrewsii*	none	none	1B
Point Reyes bird's beak	*Cordylanthus maritimus ssp. palustris*	Species of Concern	none	1B
Marin checker lily	*Fritillaria affinis var. tristulis*	none	none	1B
San Francisco gumplant	*Grindelia hirsutula var. maritima*	Species of Concern	none	1B
rosy linanthus	*Linanthus rosaceus*	none	none	1B
Marin knotweed	*Polygonum marinense*	Species of Concern	none	3
San Francisco owl's clover	*Triphysaria floribunda*	Species of Concern	none	1B
Headlands FMU				
Blasdale's bent grass	*Agrostis blasdalei*	Species of Concern	none	1B
coast rock cress	*Arabis blepharophylla*	none	none	4
Point Reyes blennosperma	*Blennosperma nanum var. robustum*	Species of Concern	Rare	1B
Franciscan thistle	*Cirsium andrewsii*	none	none	1B

Marin checker lily	*Fritillaria affinis var. tristulis*	none	none	1B
short-leaved evax	*Hesperevax sparsiflora var. brevifolia*	none	none	2
perennial goldfields	*Lasthenia marcrantha*	none	none	1B
Point Reyes meadowfoam	*Limnanthes douglasii var. sulphurea*	Species of Concern	Endangered	1B
North Coast phacelia	*Phacelia insularis var. continentis*	Species of Concern	none	1B
Point Reyes rein orchid	*Piperia elegans ssp decurtata*	none	none	1B
beach starwort	*Stellaria littoralis*	none	none	4
San Francisco owl's clover	*Triphysaria floribunda*	Species of Concern	none	1B
Estero FMU				
Blasdale's bent grass	*Agrostis blasdalei*	Species of Concern	none	1B
coast rock cress	*Arabis blepharophylla*	none	none	4
coastal marsh milk-vetch	*Astragalus pycnostachyus var. pycnostachyus*	none	none	1B
Point Reyes bird's beak	*Cordylanthus maritimus ssp. palustris*	Species of Concern	none	1B
Marin checker lily	*Fritillaria affinis var. tristulis*	none	none	1B
marsh microseris	*Microseris paludosa*	none	none	1B
Gairdner's yampah	*Perideridia gairdneri var. gairdneri*	Species of Concern	none	4
Marin knotweed	*Polygonum marinense*	Species of Concern	none	3
San Francisco owl's clover	*Triphysaria floribunda*	Species of Concern	none	1B
Limantour Road FMU				
Marin manzanita	*Arctostaphylos virgata*	none	none	1B
Point Reyes bird's beak	*Cordylanthus maritimus ssp. palustris*	Species of Concern	none	1B
California bottlebrush grass	*Elymus californicus*	none	none	4
Marin checker lily	*Fritillaria affinis var. tristulis*	none	none	1B
fragrant fritillary	*Fritillaria liliaceae*	Species of Concern	none	1B
Marin knotweed	*Polygonum marinense*	Species of Concern	none	3
Wilderness North FMU				
California bottlebrush grass	*Elymus californicus*	none	none	4
Wilderness South FMU				
Marin manzanita	*Arctostaphylos virgata*	none	none	1B
California bottlebrush grass	*Elymus californicus*	none	none	4

Highway One FMU				
Marin checker lily	*Fritillaria affinis var. tristulis*	none	none	1B
Lobb's aquatic buttercup	*Ranunculus lobbii*	none	none	4
Bolinas Ridge FMU				
Marin manzanita	*Arctostaphylos virgata*	none	none	1B
glory brush	*Ceanothus gloriosus var. exaltatus*	none	none	4
Bolinas ceanothus	*Ceanothus masonii*	Species of Concern	Rare	1B
California bottlebrush grass	*Elymus californicus*	none	none	4
Inverness Ridge FMU				
Marin manzanita	*Arctostaphylos virgata*	none	none	1B
swamp harebell	*Campanula californica*	none	none	1B
Mount Vision ceanothus	*Ceanothus gloriosus var. porrectus*	none	none	1B
California bottlebrush grass	*Elymus californicus*	none	none	4
Palomarin FMU				
Sonoma Alopecurus	*Alopecurus aequalis var. sonomensis*	Endangered	none	1B
Marin manzanita	*Arctostaphylos virgata*	None	none	1B
nodding semaphore grass	*Pleuropogon refractus*	None	none	4

NOTES:
[1] CNPS List 1B: Rare or Endangered in California and Elsewhere
CNPS List 3: Need More Information
CNPS List 4: Plants of Limited Distribution

INVERNESS RIDGE (1,250 acres) - This linear FMU runs from the western edge of Tomales Bay State Park south along Inverness Ridge to the Bayview Trail parking area. This ridge is dominated by dense stands of Bishop pine (*Pinus muricata*) in the north, which grade into Douglas-fir (*Pseudotsuga menziesii*) forests further south. The understory vegetation is dense beneath the Bishop pine, and consists of highly flammable species such as manzanita (*Arctostaphylos ssp*.) and ceanothus (*Ceanothus* ssp.). The understory of the Douglas-fir forests can be sparse, consisting primarily of grasses and herbs, or more dense, with salal and huckleberry. This FMU supports four federal plant species of management concern (Table 3), including two federal Species of Concern - Marin manzanita (*Arctostaphylos virgata*) and Mount Vision ceanothus (*Ceanothus gloriosus var. porrectus*). Northern spotted owls, federally listed as a threatened species, nest within this FMU.

The Inverness Ridge FMU is immediately adjacent to numerous residences and several business facilities (e.g., grocery stores, restaurants, delicatessens, galleries, and shops) in the communities of Inverness and Inverness Park. The proximity of dense, flammable vegetation to these communities results in an area where the risk of loss associated with fire is very high. The Vision Fire destroyed 44 homes in this area in 1995.

LIMANTOUR ROAD (4,142 acres) - This FMU consists of a corridor along the entire length of Limantour Road from the Limantour Beach parking area, up over Inverness Ridge, and down to the intersection of Limantour Road and Bear Valley Road. Much of the unit is within the Philip Burton Wilderness Area. For management purposes, it also includes the area encompassing the Point Reyes National Seashore headquarters buildings, the Bear Valley Visitor Center, and the Coast Miwok cultural exhibit at Kule Loklo.

The southwestern portion of this FMU, from Limantour Beach to Inverness Ridge, spreads out east and west of the road to include portions of the Phillip Burton Wilderness Area. Vegetation in this area is dominated by grassland and mixed coastal scrub in the southwest, which grades into Bishop pine stands and Douglas-fir forests on Inverness Ridge. An extensive salt water and brackish marsh system occurs at the Estero de Limantour, and high quality riparian corridors are located along several northeast to southwest trending creeks (e.g., Muddy Hollow, Laguna, Coast). This section of the FMU supports six plant species of management concern, three of these are federal Species of Concern (Table 3). A free-ranging herd of 28 tule elk (which are identified in special legislation as a resource the Seashore is to protect and manage) were introduced in this area in 1999. Federally-listed threatened coho salmon (*Oncorhynchus kisutsch*) and steelhead trout (*Oncorhynchus mykiss*) occupy streams in this FMU.

The section of this FMU that stretches from Inverness Ridge west to the Bear Valley area supports Douglas-fir forest, mixed conifer/hardwood forest with coast live oak, California bay, coyote brush scrub, and grasslands. There are large stands of eucalyptus near the Kule Loklo site, which are highly flammable. Northern spotted owls are known to nest in both sections of this FMU.

WILDERNESS NORTH (1,591 acres) - Douglas-fir forests interspersed with small open meadows characterize this FMU, which follows Inverness Ridge southeast from the Bayview Trail parking area to the Bear Valley Trail. The terrain is characterized by steep slopes that climb up from the east and west toward the central ridge. This FMU contains Mt. Wittenberg, the highest point in the planning area at 1,407 feet. Much of the unit is within the Philip Burton Wilderness Area. This unit also contains Sky Camp, a backcountry campground. Spotted owls are known to nest in this unit. This FMU supports one plant species of management concern (Table 3) **–** the California bottlebrush grass (*Elymus californicus*).

WILDERNESS SOUTH (2,297 acres) - This unit is largely comprised of designated wilderness land south of the Vedanta Society property (see Figure 6). It follows Inverness Ridge south to just south of Mud Lake, and includes Firtop (1,324 ft). The unit also encompasses land southwest of Firtop, reaching to the coast at Wildcat Camp. Vegetation is dominated by dense stands of Douglas-fir with significant amounts of dead and downed material present. The southwest corner of the FMU also supports high quality stands of coastal scrub, including coffeeberry, California sagebrush, coyote brush, bush monkeyflower, and lizardtail. This FMU supports two plant species of management concern, Marin manzanita (*Arctostaphylos virgata*), and California bottlebrush grass (*Elymus californicus*; Table 3). Marin manzanita is fire dependent, and in the absence of fire, this stand has become unhealthy and cannot reproduce. Encroachment of Douglas-fir has also served to reduce direct sunlight and further the “decadent” status of the Marin manzanita population in this part of the park. Shrubs in these stands are old and not reproducing, or dead.

HIGHWAY ONE (2,874 acres) - This unit begins immediately south of Five Brooks and runs along both sides of Highway One south to the Bolinas-Fairfax road. This unit includes the Olema Valley, which is characterized by the riparian corridors along Olema and Pine Gulch creeks and their tributaries. These waterways support coho salmon and steelhead trout. Above the riparian areas, the vegetation is dominated by annual grassland, mixed scrub, and hardwood communities. In many areas, the grasslands are grazed by cattle. This FMU supports dense stands of French broom and eucalyptus. Most of the unplanned ignitions that occur in the entire planning area result from car travel in this FMU.

BOLINAS RIDGE (2,381 acres) - This long, linear unit stretches from Olema, east along Sir Francis Drake Blvd, then turns south and follows Bolinas ridge to the Bolinas-Fairfax Road. The northern half of the unit contains grasslands grazed by cattle. Drainages within this area support mixed scrub, hardwood woodlands, and some Douglas-fir. The southern half of the unit supports primarily Douglas-fir and redwood forests, hardwood forests, and mixed scrub plant communities. At the southern end, the FMU supports a dense stand of maritime chaparral that supports two rare species (Table 3) - Marin manzanita and Mason's ceanothus *(Ceanothus masonii*). The latter species is a federal Species of Concern and is state-listed as rare.

PALOMARIN (2,021 acres) - Beginning in the Philip Burton Wilderness Area near Double Point, this unit follows the coastline to the southeast to the U.S. Coast Guard property, then runs inland on the northeast side of Mesa Road. This unit supports primarily mixed coastal scrub and grasslands.

The area flanking the Palomarin trailhead is characterized by an exceptional diversity of non-native plants, including eucalyptus, French broom, cape-ivy (*Delairea odorata*), pittosporum (*Pittosporum oblongata*), periwinkle (*Vinca major*), Harding grass (*Phalaris aquaticus*), kikuyu grass (*Pennisetum clandestinum*), oblong spurge (*Euphorbia oblongata*), and others. Three plant species of management concern (Table 3) are located in the Palomarin FMU.

MINIMUM MANAGEMENT UNIT (approximately 70,000 acres) - This unit contains all areas within the Seashore and the Northern District of GGNRA that are not included in the other ten units. This includes the majority of the pastoral zone (roughly 19,000 acres), which is dominated by grasslands grazed by cattle and large tracts of the Wilderness Area that support mosaics of forest, scrub and grassland. The Unit also includes large bodies of water such as Drakes Estero, Limantour Estero, Abbotts Lagoon, and Tomales Bay. The actions in this FMU include vegetation clearing around buildings and along roads, and full suppression of all fires.

Actions Common to All Alternatives

Some actions, including the continuation of the Wildland Urban Interface Initiative Program, maintenance of fire roads and trails, vegetation clearing around buildings, suppression of unplanned ignitions, public information and education, and fire monitoring would be carried out under all three alternatives. Also, the park intends to build a fire cache to store equipment regardless of the alternative selected. Each of these activities is described below.

Wildland Urban Interface Initiative Program

In 2001, the NPS began implementing provisions of the federal Wildland Urban Interface (WUI) Initiative program. This program was designed to facilitate cooperative ventures with park neighbors (including other federal agencies, states, counties, private landowners, and local fire agencies) to reduce the potential for wildland fire to burn from federal lands to neighboring properties.

The emphasis of this program at the Seashore is to reduce the density of hazardous fuels that create a risk to lives or property, both on and off Seashore lands. Working cooperatively with FireSafe Marin Inc., a California 501(c)(3) public benefit corporation, PRNS has provided funding for numerous projects to reduce fuel hazards and increase fire prevention and public safety. This program would continue under all alternatives.

Maintenance of Fire Roads and Trails

The Seashore routinely clears vegetation and debris from selected dirt and paved roads that provide routes for emergency evacuation and access for fire suppression activities or conducting prescribed burns, or that serve as control lines for prescribed fire projects. The minimum requirement for defensible space along roadways is 10 feet on each side. This specification provides only the minimum degree of safety for firefighters and the public and is prescribed by California Public Resource Code (PL - 4290 and 4291). An assessment of road conditions is performed in early summer, then a work plan is developed and vegetation clearing needs are prioritized.

For road clearing, trees along the sides of the roadways are limbed up to 10 feet in height as needed. Native tree species that would be limbed include Douglas-fir and Bishop pine. Trees less than four inches in diameter (dbh) are removed from 10-15 ft wide corridors on each side of the road (measured from the edge of the roadway). This width can increase to 20 feet wide where roads cross topographic saddles. Downed trees in or near the roads are cleared. Grass growing up within roads is cut or mowed. Marin County mows grasses along county-maintained roads.

Tools used for these tasks include weed-whackers, chain saws, pole saws, and a chipper towed to the site by a truck. Vegetation debris can be cut up and broadcast in the immediate area, or piled and burned. Debris that is not broadcast on site is chipped and hauled to Beebe Ranch and stockpiled. In accordance with BAAQMD Regulation 5, debris piles could only be burned at Beebe Ranch with the approval of the Air Pollution Control Officer. Chipped material is not burned.

Routine maintenance is performed on all fire roads and trails listed in Table 4 below, with the exception of Bolinas Ridge Fire Road, where it is less frequent.

Assessment and maintenance activities conducted on fire roads would include regrading where rills and gullies have formed. Where necessary, road regrading should follow standard local practices established in the Road Maintenance MOU and the Trail Assessment document. Marin County Open Space has used this method to recontour and enhance Fire roads on Marin County Open Space District Land. This includes outsloping of roads to prevent rill and gully erosion. This is acceptable as vehicle access on fire roads is only necessary in the dry period of the year.

Table 4. Fire Roads and Trails in Pt. Reyes Receiving Annual or Periodic Maintenance

Road Name	Location
Gunn Road	Inverness Ridge
Bayview Road	Inverness Ridge
Upper Vision Road	Inverness Ridge
Bolinas Ridge Fire Road	Bolinas Ridge
Limantour Road between Sky Camp and Kule Loklo	Inverness Ridge
Stewart Trail	Inverness Ridge
Randall Trail	Bolinas Ridge
Coast Trail	Limantour Area
Inverness Ridge Trail	Inverness Ridge
Sky Trail	Inverness Ridge
Mount Vision Road	Inverness Ridge
McCurdy Trail	Bolinas Ridge

Vegetation Clearing around Buildings

Seashore staff routinely clear hazardous fuels (vegetation and flammable debris) adjacent to structures within the project area. These actions would be continued under all alternatives. Structural clearing conforms to or exceeds the requirements of California Public Resource Code (PL-4290 and 4291), which also dictates the parameters for structural safety in surrounding residential communities. This code requires a minimum 30-foot cleared buffer of defensible space around all structures.

Structural clearing projects are prioritized annually and performed in early summer. The defensible space required at each structure is based on individual site topography, and usually ranges from 30-50 feet around structures. In some cases, a larger cleared area may be required to protect the structure from potential fire hazard due to prevailing winds or the presence of drainages or swales close to the structure. Large trees are pruned or removed if the tree poses a threat, grasses are cut to stubble, and smaller trees are pruned or removed based on individual site topography. The health of all trees within the defensible space is assessed and any dead or dying trees are removed.

NPS maintenance, fire, and engineering staff conduct fire inspections of each building during the winter to assure that all structures meet fire code requirements.

Suppression of Unplanned Ignitions

The current policy at the Seashore is to suppress all unplanned ignitions using Minimum Impact Suppression Tactics (MIST). MIST guidelines apply to all facets of suppression actions and direct personnel to implementation techniques that minimize long-term adverse effects on wildlands. These tactics will be outlined and defined in the park's operational guidelines. Since 1997, an average of three wildland fires per year have occurred at Point Reyes. All of these were kept less than ten acres in size; most were extinguished at less than one acre. To accomplish this, Point Reyes has had a 10-person Hazard Fuels Crew, 1-2 Engine Technicians, and support from the GGNRA and the Marin County Fire Department. Most of the fires occurred in the Olema Valley, and all but one were human-caused.

Fire suppression actions typically include fire line construction and laying hose. A fire line (approximately 18 to 24 inches wide) is cut and cleared to bare mineral soil using chainsaws, shovels, and other hand tools such as Pulaskis (a shovel/hoe firefighting tool) and McLeods (a scraper firefighting tool). Fire line construction can include cutting brush, limbing trees, and cutting snags.

It is also possible that, during an emergency situation where an unplanned ignition has grown to a large and dangerous fire (such as during the Vision Fire), the superintendent would authorize the use of heavy motorized equipment such as bulldozers to construct larger and longer fire lines.

Other fire suppression activities require limited off-road vehicle use by trucks, fire engines, and lowboys for hauling heavy equipment.

Air drops of retardant foam and water may occur during suppression of unplanned ignitions. Retardant foam (e.g., Phoschek) contains phosphorus. Water drops could also be made, using water from ponds in the Seashore. Helicopters will need areas to land (helispots) within the Seashore. The Seashore Aviation Management Plan addresses safe locations for landing in areas administered by the park. Temporary road and trail closures may occur during fire suppression events.

Public Information and Education

A comprehensive public information and education program would be included as part of all of the alternatives. PRNS and GGNRA share a full-time fire education specialist. The program's emphases include fire safety and prevention, fuels management, the role of fire in PRNS's ecosystems, the Seashore's fire history and the cultural use of fire on the landscape, and fire research programs and opportunities. The following list illustrates several key components of the program.

Notification of fire management activities would be done prior to project commencement using road and trail signs, and postings at visitor centers, entrance stations, post offices, and other areas of high visitor use. Flyers would be distributed to residences and businesses, and posted throughout western Marin County in strategic locations (e.g., post offices) to notify the public of upcoming prescribed burns. Homeowner Associations and specific individuals would be contacted by phone or email prior to prescribed burning.

Communication with adjacent land management agencies (e.g., State Parks, Marin County, Marin Municipal Water District) would always be conducted when projects occur at or near their boundaries. They also would be notified if a project on Seashore lands has potential to affect lands under their jurisdiction.

When prescribed fires or unplanned ignitions are visible from scenic overlooks or popular visitor use areas, park interpreters or the Seashore's fire education specialist would be present to alleviate public concern and to educate visitors on the objectives and benefits of prescribed burning.

The Public or Fire Information Officer (P/FIO, respectively) would notify adjacent communities by press release, as requested, before implementing prescribed fires.

PRNS staff would follow the standard operating procedures for implementing a Fire Step-up Plan during fire season. For example, when red flag warnings are issued by the National Weather Service (Sacramento Office), fire managers would post high fire danger signs within the park.

In the event of wildland fire, the P/FIO would work closely with visiting FIOs who may be part of Incident Management Teams to assure the park message is delivered accurately and effectively. Wildland fires will also be reported to BAAQMD as soon as possible. Media and public queries would receive prompt replies and would contain information about the fire, the fire management plan, and ecosystem restoration as appropriate.

Fire Monitoring

Monitoring of fire effects has been occurring in prescribed burn units at PRNS since 1991. Monitoring of fuels, weather, air quality, and fire behavior for wildland and prescribed fires would generally follow the protocols outlined in the NPS Fire Monitoring Handbook (FMH)(NPS, 2003a). Under these protocols, photo points and vegetation transect data are used to assess attainment of objectives. Short and long-term objectives applicable to a specific burn area would be stated in individual Prescribed Burn Plans.

Monitoring data are archived and reviewed to refine target conditions and burn prescriptions, and to determine program effectiveness. Most of the existing FMH plots are located in Divide Meadow, the Olema Valley, Estero Trail, and southern Bolinas Ridge. Under all alternatives, these plots would continue to be monitored and additional plots would be established in any new habitat types subject to prescribed burning.

Mitigation measures to ensure the protection of cultural resources are enumerated in detail in the impact analysis in Chapter 4. Some of the larger actions the Seashore would take include monitoring to document pre- and post-burn conditions that are readily observable, such as the condition of flammable historic fabric (e.g., elements that contribute to the structure's integrity, such as original siding, shingles, etc.), preservation of milling slicks on archeological sites, visually identifiable changes in surface artifacts and surface conditions, and changes in landscape conditions in historic district and cultural landscape areas. Surveys of cultural resources would be conducted prior to all prescribed burns. As needed, fuel loads that might threaten a cultural resource during a prescribed burn or unplanned ignition would be lightened.

Prior to prescribed burns, known cultural resources would be evaluated to the extent possible and current conditions would be assessed, using standard operating procedures. This would include documentation of current fuel loads, threats to features and artifacts, and potential for subsurface impacts through root and/or stump burn.

For wildland fires, a cultural resource specialist or resource advisor would be present during all fire management actions where recorded and unrecorded resources of interest are considered at risk. The specialist or advisor would provide documentation of fire behavior and immediately observable effects of fire in and adjacent to cultural resources. If suppression or holding actions must be taken, the specialist or advisor would help in deciding site-specific actions. Following a fire, an archeologist would revisit known cultural resources in burn areas to document fire effects and/or changes in condition and assess post-burn protection needs. Fire effects would be documented and added to the database on cultural resource fire effects.

Fire effects monitoring data will be analyzed and reviewed every five years using standard scientific analysis techniques and outside reviewers. New management questions may arise from these analyses that may require alternative strategies that are applied following the principals of adaptive management. For example, burning in areas with highly invasive non-native plants may result in enhancing the spread of the non-native species. An adaptive strategy might be to swamp the non-native seeds in the burn area with native seeds.

Fire Program Cache

Currently, fire control vehicles and equipment are stored at the Hagmaier Complex, located on Highway One approximately six miles south of park headquarters at Bear Valley. The current building is a former barn and has inadequate equipment storage space, no insulation or heating, poor lighting, insufficient windows, and limited office space. In addition, the majority of fire fighting staff members are currently stationed at Bear Valley (Park Headquarters). This creates a delay in accessing vehicles and equipment, which increases response time to unplanned ignitions at major park assets. Storage of fire equipment and vehicles in a central location would decrease response time to major park assets and facilitate communication between park staff members responsible for fire management. Internal scoping among specialists in different fields in the park indicated the cache should ideally be located near park headquarters for logistic and technical reasons. In addition, the environmental effects of siting the building near existing buildings would be minimal. Park staff members have identified a location adjacent to the roads and trails facility at the Bear Valley administrative area as its preferred choice for the cache. The site was formerly used for a trailer pad.

General Description of Prescribed Fire and Mechanical Fuels Treatments

Under all alternatives, prescribed burning and mechanical fuel treatments would be carried out to meet program goals and objectives as described in Chapter 1 (Purpose of and Need for Action). Site-specific objectives, as well as locations, size, and timing of burns and treatments would vary, however, among the alternatives. The following sections provide detailed information on the steps that occur when a prescribed fire is implemented, and a discussion of the various types of mechanical fuel treatments that may be used under the three alternatives.

Prescribed Fire

Every year fire management and resource management personnel identify priority areas for prescribed burning. Projects then are scheduled for implementation. After a project area is selected, fire personnel visit the site to define its boundaries by placing flags at the perimeter. The site may also be mapped using a Global Positioning System (GPS). After surveying for cultural resources and completing internal environmental screening for other affected physical or natural resources, a burn plan is prepared for each unit.

The burn plan is submitted to an outside expert, and both the expert and the park's Fire Management Officer provide a recommendation to the superintendent. After the burn plan is approved by the superintendent, an application for permission to conduct a prescribed burn is made to BAAQMD.

The burn plan estimates the percentage of the unit covered by different fuel types and of the tons of material to be burned. This information is fed into an air quality model for the burn, which is submitted as part of the application submitted to BAAQMD. BAAQMD approval requires that the NPS submit a Smoke Management Plan (SMP) and completed application materials for all prescribed burns at least 30 days prior to the proposed burn date.

With the approval of the smoke management plan, the NPS begins final planning for the prescribed burn and the project site is prepped for the burn. To prepare for a burn in grassland habitat, a line is mowed around the perimeter of the burn by cutting grasses with either a weed whacker, mower, or tractor. In shrub or forested habitats a fire line (approximately 18 to 24 inches wide) is cut and cleared and vegetation density reduced as described above under the heading "Suppression of Unplanned Ignitions." Whenever possible, roads and trails are used as fire lines to reduce the amount of line that must be created. A hose lay is set up along the burn perimeter no more than one week prior to the burn. If the burn in being conducted in non-native tree or shrub stands (e.g., Monterey pine or Scotch broom), the non-natives may be cut down or mowed and left in the burn unit to dry before burning. This increases mortality of the targeted non-native species.

As the proposed burn day approaches, NPS staff contact BAAQMD's Meteorology and Data Analysis section, which provides forecasting services to assist with tentative scheduling of prescribed burns. The MDA section will provide 96-hour, 72-hour, 48-hour, and 24-hour forecasts and a 24-hour confidence level of receiving the final approval on the day of the burn itself. The NPS telephones BAAQMD between 8:30 a.m. and 1:30 p.m. on the burn day to receive final approval and an acreage burning allocation for that day. BAAQMD requires verification that the meteorological conditions fall within the range described in the SMP. The BAAQMD makes a final decision based on wind and weather as to whether it would permit the burn. The burn is lit using a drip torch with a mixture of diesel and gasoline (3:1). This fuel is stored in a hazardous materials locker in the park and transported within the park in accordance with state and federal regulations.

During the burn, park fire staff patrol the fire line and keep it secure by watching for and suppressing any spot fires and turning any logs that could potentially roll out of the burn and spread the fire. Vehicles (pick up trucks or fire trucks) may be used to drive the perimeter to patrol the fire. Additional fire line may be cut if required to control spot fires using hand tools or chain saws. The spot fire is extinguished using water, hand tools, and if necessary, power tools. Fire weather is carefully monitored during the burn to ensure that the conditions stay within the burn prescription.

Following the burn, the burn crew determines whether or not "mop up" is necessary to ensure that all fire is completely extinguished. Mop up activities include digging, cutting, trenching (to prevent debris from rolling), chinking (taking a pulaski and clearing burning material off a log), chunking (putting smoldering material into one pile and letting it burn up), and mixing dirt with water from backpack pumps or from hoses. Any smoldering that is causing nuisance smoke is extinguished.

Prescribed fire personnel monitor the fire until dark or until the perimeter is secured. Personnel would stay on site overnight for burns in forested habitats. The burn area is patrolled the day after burning by walking the perimeter and doing any additional mop up activities required. As required by BAAQMD, the total acreage of burned vegetation is reported by telephone to them by noon the day following the prescribed burn.

Mechanical Fuels Reduction

Mechanical treatment includes the following:

- Fuel breaks - clearing corridors completely of vegetation.
- Shaded fuel breaks – density of underbrush reduced; tree limbs removed.
- Mosaics of cleared areas, areas with reduced vegetation density, and uncleared area.
- Using animals to reduce fuels (cows or goats).
- Removing non-native trees and treating cut stumps with herbicide.

Every year fire management and resource management personnel identify priority areas for mechanical treatments such as mowing or hand fuels removal. Projects then are scheduled for implementation. After a project area is selected, fire personnel visit the site to define its boundaries by placing flags at the perimeter. The site may also be mapped using a Global Positioning System (GPS). Treatments are documented to ensure that a park has a historical record of the types of landscape treatments each area has been subjected to.

After the site and project environmental review process is completed, the project is approved by the superintendent with mitigations if appropriate. For example, specific appropriate mitigation measures could include leaving buffers along riparian zones and wetlands and/or creating a larger buffer around an archeological site.

If herbicides are used, they are applied according to strict specifications using detailed Material Safety Data Sheets. Any application requires the approval of the park's Integrated Pest Manager and the Washington Office coordinator for herbicide application. No applications occur in riparian or wetland areas.

If goats or other animals are used as a type of mechanical treatment, they are closely monitored and contained by electric fences to eliminate the potential for feral animals or contamination of adjacent water resources. Grazing treatments would be limited to the number of days needed to conduct the fuel treatment in order to minimize any potential impacts to soil or water quality.

Following the mechanical treatment, the site would be reviewed by park staff for any newly uncovered and previously unknown archeological material that may need preservation treatment. Sites would be monitored by park staff over the course of several years to review the success of the treatments. If invasive exotics are found, other treatments would be planned and implemented on the project area.

Alternative A (No Action) - Continued Fuel Reduction for Public Safety and Limited Resource Enhancement

Under Alternative A the Seashore would continue to apply existing fire management practices by implementing elements of the 1993 Fire Management Plan. Under this alternative, the Seashore would comply with the requirement of NPS Director's Order 18 to develop a new Fire Management Plan based on guidelines outlined in NPS Reference Manual 18, but the fire and fuels management actions in the new plan would not differ from current practices. The emphasis of the existing program is to use both prescribed burning and mechanical treatment to:

- Reduce hazardous fuels along primary roads (e.g., Highway One); and
- Reduce the aerial extent and density of several non-native invasive plant species including Scotch and French broom, Monterey pine, and eucalyptus trees.

Continuation of the existing fire management program and practices under Alternative A would allow the Seashore to minimally meet program goals as listed in the Fire Management Plan Goals section of the Purpose and Need chapter. Alternative A would not be as effective as Alternative C in meeting the goal to improve conditions for and protect natural resources, but would be comparable to Alternative B in the degree to which it meets this goal. The No Action alternative may also be less effective than the action alternatives (e.g., alternatives B and C) in meeting goals 6 and 7, which address public education and understanding of fire and an understanding by park staff of the specifics of fire behavior and effect inside the Seashore.

Under this alternative, a maximum of 500 acres would be subject to prescribed burning and a maximum of 500 acres would be subject to mechanical fuel treatments. Every five years, fire management and resource management personnel would develop specific plans for prescribed burning and mechanical treatments that would be subject to an NPS internal project review process. These five-year burn plans would in turn be reviewed annually and updated as needed. Fire management staff would draw from these plans to do all of the detailed work that goes into a site specific burn plan described above.

Under the No Action alternative, six FMUs (Tomales Point, Headlands, Inverness Ridge, Wilderness North, Wilderness South, and Palomarin) would not be subject to prescribed burning or mechanical treatments except those actions prescribed for the Minimum Management Unit (e.g., suppression of unplanned ignitions, mechanical vegetation clearing along roads and around

Figure 7. Map of Project Area Showing Alternative A FMUs

structures). This is because, as noted above, the focus of the existing fire management program (which would continue under No Action) is the management of hazardous fuels along primary roads and the reduction of non-native invasive plant species through prescribed burns and mechanical treatment. The four remaining FMUs to be treated - Estero, Highway One, Bolinas Ridge, and Limantour Road - contain primary roads and the majority of non-native broom species, as well as Monterey pine and eucalyptus (See Figure 7). The focus of treatment in each is described below:

Prescribed Fire

Prescribed burning would continue to occur on a maximum of 500 acres per year within the Estero, Limantour Road, Highway One, and Bolinas Ridge FMUs. The burns could occur in any of these FMUs, but the total acres burned within the Seashore would never exceed 500 acres in any given year. The focus and intent of prescribed burns in each FMU is outlined below. Three of these units (Limantour Road, Highway One, and Bolinas Ridge) are along primary park roads where the majority of unplanned ignitions occur and the potential for a major wildfire exists. Estero FMU is included because it contains large tracts of invasive Scotch broom, the control of which is a focus of the Seashore's use of prescribed fire under the No Action alternative.

Estero - The Seashore would continue to conduct prescribed burns to contain and reduce the extent and density of the non-native plants Scotch broom and Monterey pine. Research would be conducted on the Scotch broom burn sites to determine the effects of prescribed burning on Scotch broom aerial extent and density.

Limantour Road - Prescribed burns would continue to be conducted near the Limantour Road parking area if required to eradicate Monterey pine.

Highway One - Prescribed burns would continue in the central and southern portions of the unit to reduce hazardous fuels and to control the non-native French broom.

Bolinas Ridge - Training burns would be conducted in the northern section of this FMU. Research burns to determine the effects of prescribed burning on the non-native plant velvet grass, and on two rare plant species (Marin manzanita [*Arctostaphylos virgata*] and Mason's ceanothus [*Ceanothus masonii*]) that require fire to flourish, would occur in the southern section of this FMU.

Mechanical Fuel Treatments

In addition to routine clearing of hazardous fuel around structures and along fire roads, the Seashore would continue to conduct more extensive mechanical fuel treatments in the Estero, Limantour Road, and Highway One FMUs. Mechanical treatments would occur on a maximum of 500 acres per year. The treatments could occur in any of these FMUs, but the total acres treated within the Seashore would never exceed 500 acres in any given year. Some of the acres that are mechanically treated may also be burned (e.g., Scotch broom may be mowed prior to burning). The focus and intent of mechanical treatments in each FMU are outlined below.

Estero - Mowing and cutting of non-native Scotch broom and Monterey pine would continue.

Limantour Road - Monterey pine near the Limantour Road parking area would be cut.

Highway One - Grasslands would be mowed along both sides of the highway to reduce hazardous fuels and to control French broom.

Fire Effects and Fuel Management Research

Fire effects research on targeted species was initiated in 1999. Studies include the effects of prescribed burning on controlling Scotch broom in the Estero FMU and velvet grass on Bolinas Ridge, and on stimulating Marin manzanita and Mason's ceanothus on Bolinas Ridge. None of the research plots were burned in 2000 due to the NPS burn moratorium. In 2001 the park burned approximately five acres of research plots as part of a study to determine the effects of prescribed fire on Scotch broom in the Estero FMU. Fire history studies using tree ring and sediment core analysis also have been ongoing in the Seashore.

Under Alternative A, research burns on velvet grass and Scotch broom would continue in order to allow Seashore ecologists to refine burning prescription parameters to control these species. Planned research burns on Marin manzanita and Mason's ceanothus would be conducted as planned to determine how best to use fire in managing these species. Research on fire history of the Seashore would continue under contract with Rocky Mountain Tree Ring Research and Northern Arizona University. Additionally, non-NPS researchers have been studying the effects of fire on plant communities and wildlife (NPS, 2003b; G. Geupel, Point Reyes Bird Observatory, pers. com.; G. Fellers, USGS-BRD. pers. com.). Northern spotted owls, dusky-footed woodrats, and land birds have specifically been targeted for study of fire effects in order to meet compliance requirements under Endangered Species Act.

Alternative B - Expanded Hazardous Fuel Reduction and Additional Natural Resource Enhancement

Under Alternative B, the Seashore's fire and fuel management program would focus on reducing hazardous accumulations of vegetation (fuels). Mechanical thinning and prescribed burning would each be used to treat a maximum of 1,000 acres, or double that of the No Action alternative. All treatments would be applied in areas where fuel reduction activities would have the highest likelihood of reducing the risk of wildland fire to lives and property. Prescribed fire and mechanical treatment would also be used to treat non-native invasive plants as it is in Alternative A, but the acreages and species treated would expand. In addition to the treatment described above for FMUs under the No Action alternative, Alternative B would focus additional treatment on the following areas:

- Sites where fuel accumulations have created situations where an unplanned fire in these fuels would directly threaten human lives or property, and

- Sites where reduced levels of fuels could help firefighters slow or stop the spread of fire in the event of an unplanned ignition, such as along Highway One.

While this alternative would meet the goals of the Seashore's fire program, it would not be as effective as Alternative C in improving conditions for natural resources. As in Alternative A,

Figure 8. Map of Project Area Showing Alternative B FMUs

natural resource enhancement under Alternative B would occur only as a secondary benefit in areas that were treated for fuel reduction. For example, natural resource enhancement benefits associated with prescribed burning under this alternative would include reduction of the non-native French broom in the Highway One FMU. It would, however, differ from Alternative A in that more acreage would be treated to control invasive non-native species, a natural resource objective of the Seashore.

This alternative would also not be as effective as Alternative C in achieving the goal of improving the staff's knowledge and understanding of fire inside the park. However, it would include the provision for test burns in vegetation communities where no research is currently conducted or would be conducted under Alternative A. These include Douglas-fir stands, Bishop pine forests, coastal scrub, and some grassland habitats. The results of these test burns would help Seashore staff to determine with more accuracy the prescription needed to effectively manage these vegetation types.

As in all alternatives, every five years fire management and resource management personnel would develop specific plans for prescribed burning and mechanical treatments that would be subject to PRNS's internal project review process. These five year burn plans would in turn be reviewed annually and would be updated as needed.

Under Alternative B, all FMUs except the Headlands FMU would be subject to prescribed burning or mechanical treatments as described in the following sections (See Figure 8). The Headlands FMU would be subject only to those actions that are prescribed for the Minimum Management Unit (e.g., suppression of unplanned ignitions, mechanical vegetation clearing along roads and around structures). This is because the Headlands FMU is neither a high priority area for enhancement of natural resources nor an area of major concern with regards to invasive exotic plant species.

Prescribed Fire

Implementation of Alternative B would result in a substantial increase in the acres that could be subject to prescribed burning (e.g., the maximum number of acres that could be burned in any given year would double - from 500 to 1,000) when compared to Alternative A.

In many of the Seashore's habitat types, including Douglas-fir stands, Bishop pine forests, coastal scrub, and some grassland habitats, detailed site-specific information on the ecological effects of prescribed burning is not available. For example, in some areas, there is potential for the introduction of invasive non-native plants following burning. To ensure that prescribed burns are not resulting in adverse impacts, the Seashore plans to conduct small pilot project burns in these habitats, as described below, to assess actual impacts on a small-scale before proposing larger scale burns. In addition to the four FMUs where prescribed burns would take place in Alternative A, an additional four would be treated in this alternative. The eight FMUs where prescribed burns could be conducted are:

- Estero
- Inverness Ridge

- Limantour
- Wilderness North
- Wilderness South
- Highway One
- Bolinas Ridge
- Palomarin

The prescribed burns could occur in any of these FMUs, but the total acres burned within the Seashore would never exceed 1,000 acres in any given year. Most areas that would be subject to prescribed burning would be located within 0.5 miles of roads or major trails. The focus and intent of prescribed burns in each FMU is outlined below.

Estero – As in Alternative A, prescribed burns would be conducted to contain and reduce the extent and density of the non-native plants Scotch broom and Monterey pine. Current research on the Scotch broom burn sites would continue to determine the effects of prescribed burning on Scotch broom aerial extent and density.

Inverness Ridge - To date, prescribed burns have not been conducted in this FMU. Under this alternative, burns within this FMU would include small pilot projects (less than 30 acres) in Bishop pine forest to determine if such burns effectively reduce understory biomass and dead and downed fuels, and whether burning results in invasion by non-native plant species.

Limantour Road - In the past, prescribed burns have occurred within this FMU near the Limantour Beach parking area to reduce the density of Monterey pine trees. Burning in this area would continue. Additional burning would occur in grasslands and shrublands along the Limantour Road corridor to reduce hazardous fuel accumulations. This FMU also contains the area around the Bear Valley NPS Headquarters, the Bear Valley Visitor Center, and the Kule Loklo visitor use site. Small prescribed burns would be conducted in grasslands or shrublands in these areas to reduce fuel accumulations.

Wilderness North - To date, prescribed burns have not been conducted in this FMU. Initial burns would consist of pilot projects (less than 100 acres) in Douglas-fir forest and grassland near Mt. Wittenberg to determine the effectiveness of burning in these areas. The objectives of these burns would be to reduce understory biomass and stem density, to break up the continuity of ladder fuels, and to establish potential future staging areas to be used in the event of a wildfire.

Wilderness South - To date, prescribed burns have not been conducted in this FMU. Initial burns would be pilot projects (less than 100 acres) in Douglas-fir forest and grassland near Firtop to determine the effectiveness of burning in these areas. The objectives of these burns would be to reduce understory biomass and stem density, to break up the continuity of ladder fuels, and to establish potential future staging areas to be used in the event of a wildfire.

Highway One - Prescribed burns in the past in this FMU have been concentrated on grasslands that support the non-native plant French broom. Prescribed burning would continue in these areas, and would be expanded to further reduce grasses and other herbaceous fuels along both sides of the highway corridor.

Bolinas Ridge - In the past, prescribed burns have occurred only in the northern end of this FMU on the site of a former Christmas tree farm. Burns would continue at this site, and would also be conducted in the Beebe Ranch area, and in grasslands and shrublands along Bolinas Ridge. Grasslands along the western portion of Sir Francis Drake Boulevard would be subject to prescribed burning to create a corridor of defensible space along the road. A large portion of the northern half of this FMU is subject to grazing by cattle, which serves to reduce fuels. The area of emphasis for prescribed burning, therefore, would be on the southern half of the FMU along the Bolinas Ridge Fire Road. These burns would be conducted in cooperation with the Marin Municipal Water District. Prescribed burns in the southernmost portion of the ridge in coastal chaparral and mixed scrub habitats would also help achieve a natural resource benefit by stimulating reproduction in the rare, fire adapted species Marin manzanita and Mason's ceanothus.

Palomarin - To date, prescribed burns have not been conducted in this FMU. Burns would be conducted to reduce hazardous fuel accumulations and French broom populations near the Commonweal garden site and near the Palomarin Trailhead. Small-scale pilot burns also would be conducted to reduce fuels, and to discourage Douglas-fir encroachment on coastal scrub habitats around the Point Reyes Bird Observatory (PRBO) field station to create a mosaic of vegetation in the area and improve habitat for birds. Burns in coastal scrub would generally be less than 100 acres and used in part to determine effects.

Mechanical Treatments

Implementation of Alternative B would result in a substantial increase, when compared to Alternative A, in acres subject to mechanical treatments to reduce hazardous fuel accumulations, and to create and maintain defensible space and fuel breaks (i.e., the maximum number of acres that could be treated in any given year would increase from 500 acres to 1,000 acres). In addition to the three FMUs where mechanical treatment would be used under Alternative A (Estero, Limantour, and Highway One), the Seashore would treat fuels more extensively in five additional FMUs. These treatments would be more extensive than the routine clearing of hazardous fuels around structures and along fire roads identified above in Actions Common to All Alternatives. The eight that would receive this additional mechanical treatment are:

- Tomales Point
- Estero
- Inverness Ridge
- Limantour Road
- Wilderness North
- Wilderness South
- Highway One
- Palomarin

The treatments could occur in any of the FMUs listed, but the total acres treated within the Seashore would never exceed 1,000 acres in any given year. Some of the acres to be mechanically treated would be the same acres that are subject to prescribed burning (e.g., Scotch broom may be mowed prior to burning). The focus and intent of mechanical treatment in each FMU are outlined below.

Tomales Point - Eucalyptus and Monterey cypress trees around Pierce Point Ranch would be subject to cutting and stump treatment with herbicides.

Estero – In addition to mowing and cutting non-native Scotch broom and Monterey pine, actions described in Alternative A, Alternative B may add cutting and stump treatment with herbicides of non-natives eucalyptus and Monterey cypress.

Inverness Ridge - A shaded fuel break may be constructed and maintained along a 3-mile long portion of Inverness Ridge. This fuel break would be constructed to reduce the risk of fire burning from Seashore lands onto adjacent private lands. Initially, a 0.25-mile section of fuel break would be constructed as a pilot project to evaluate the effectiveness of such a fuel break, and to determine and evaluate the significance of environmental effects of constructing and maintaining the fuel break. The fuel break would extend from the Bay View Trail Parking Area to the Point Reyes Hill and would be approximately 50-60 feet wide. Within the fuel break, dead and downed woody debris would be reduced by 60%, trees would be limbed up to 10 feet in height, trees up to 4 inches in diameter would be thinned, and brush would be cut in a mosaic pattern to break up fuel continuity.

Limantour Road – As in Alternative A, non-native Monterey pine near the Limantour Road parking area would be cut. In addition, areas along Limantour Road would be subject to vegetation clearing. Trees along the sides of the road, primarily Douglas-fir, would be limbed up to a height of 10 feet. Trees less than four inches in diameter (dbh) would be removed from a corridor 10 - 15 feet wide on each side of the road (measured from the edge of the roadway). This dimension could increase to 20 feet wide where the roadway crosses a saddle. Downed trees in or near the roadways would be cleared. Grasslands along the road would be mowed.

Wilderness North - Under this alternative, prescribed burns up to 100 acres in size would be conducted in this FMU. Douglas-fir forests would be subject to mechanical thinning prior to prescribed burning if such action is deemed necessary to enhance the ecological value of the burn and to ensure the burn can be conducted safely.

Wilderness South - Under this alternative, prescribed burns up to 100 acres in size would be conducted in this FMU. Douglas-fir forests would be subject to mechanical thinning prior to prescribed burning if such action is deemed necessary to enhance the ecological value of the burn and to ensure the burn can be conducted safely.

Highway One – As in Alternative A, grasslands along the highway would be mowed to reduce hazardous fuels, to create a corridor of defensible space along the highway, and to control French broom. In addition, Alternative B would include thinning or removal of non-native eucalyptus stands near McCurdy Trail, Dogtown, Hagmaier, and possibly at other locations in this FMU.

Palomarin - Areas along the road would be subject to vegetation clearing. Trees along the sides of the roadways would be limbed up to a height of 10 feet. Trees less than four inches in diameter (dbh) would be removed from a corridor 10 - 15 feet wide on each side of the road (measured from the edge of the roadway). This dimension could increase to 20 feet wide where the roadway crosses a saddle. Downed trees in or near the roadways would be cleared. Grasslands along the road would be subject to mowing. Douglas-fir encroaching into coastal scrub near the PRBO Palomarin field station would be cut before this site is burned.

Fire Effects and Fuel Management Research
All of the same research described under Alternative A, such as effects of prescribed burning on Scotch broom, velvet grass, Marin manzanita, and Mason's ceanothus would take place in this alternative as well.

As in Alternative A, research on fire history of the Seashore would continue under contract with Rocky Mountain Tree Ring Research and Northern Arizona University. However, new research would be initiated under this alternative to determine the effectiveness of mechanical treatments (e.g., shaded fuel breaks) at reducing hazardous fuel loads and the effects of such treatments on ecosystem elements. In addition, Alternative B includes the use of small test burns in vegetation communities such as Douglas-fir forest and coastal scrub to determine its effects. Specific research topics that could be included under this alternative include the following:

Inverness Ridge - the effects of prescribed burning on Bishop pine populations and associated plant species within the Bishop pine community would be evaluated.

Wilderness North – the effects of prescribed burning on Douglas-fir forest communities would be evaluated.

Wilderness South - the effects of prescribed burning on Douglas-fir forest communities would be evaluated.

Bolinas Ridge - the effects of prescribed burning on coastal grassland and chaparral plant communities would be evaluated to determine if fire can be used to increase native species richness and/or density.

Palomarin – the effectiveness of prescribed burning at reducing density or diversity of non-native plants would be assessed; the effects of prescribed burning and mechanical treatments on birds would be assessed in conjunction with the Point Reyes Bird Observatory.

General Research - researchers would continue to study the effects of fire on plant communities and wildlife (G. Geupel, Point Reyes Bird Observatory, pers. com.; G. Fellers, USGS-BRD, pers. com.). Northern spotted owls, dusky-footed woodrats, and land birds would continue to be specifically targeted for study of fire effects in order to meet compliance requirements under Endangered Species Act.

Alternative C - Increased Natural Resource Enhancement and Expanded Hazardous Fuel Reduction

Alternative C is designed to provide the fire and fuel management program with maximum flexibility in the application of management treatments. This alternative would include all activities described in Alternative B, plus additional activities designed to protect and enhance natural and cultural resources in the Seashore. Research activities would increase over the other alternatives. Prescribed burns and mechanical treatments would emphasize the following:

- Reduction of hazardous accumulations of vegetation (fuels) in areas where these activities would have the highest likelihood of reducing the potential risk of wildland fire to lives and property;

- Enhancement of the conditions of natural resources (e.g., increasing abundance or distribution of T&E species; reducing infestations of invasive, non-native plants; increasing native plant cover); and

- Protection or enhancement of cultural resource elements and values (e.g., burning would be used to reduce vegetation in areas that are identified as important historic viewscapes).

As with other alternatives, Alternative C would meet the goals of the Seashore's fire program as stated in the Purpose and Need chapter. Of all alternatives, Alternative C would most fully meet the goals of maintaining or improving the condition of natural resources (goal 3) and improving both the knowledge of fire and refinement of fire management practices through research and monitoring (goal 7). In addition, because it includes treatment over many more acres than the other alternatives, Alternative C would meet the goals of protecting public safety (goal 1) and property (goal 2) to a greater degree.

Under this alternative, a maximum of 2,000 acres would be subject to prescribed burning and a maximum of 1,500 acres would be subject to mechanical treatments. As in other alternatives, every five years fire management and resource management personnel would develop specific plans for prescribed burning and mechanical treatments that would be subject to NPS internal project review process. These five-year burn plans would in turn be reviewed annually and updated as needed. Under Alternative C, all FMUs would be subject to prescribed burning (See Figure 9).

Prescribed Fire

Implementation of Alternative C would result in a substantial increase in the acres that could be subject to prescribed burning. As noted above, the maximum number of acres that could be burned in any given year would quadruple compared with Alternative A and double compared with Alternative B.

Limited information currently exists on the natural frequency (e.g., without any human influence) of lightning fires in the Seashore. In addition, accumulations of fuel in many areas far exceed what would have been present if the ecosystems had been burning at regular intervals. Therefore, prescribed burns intended for resource enhancement initially would be small and would be subject to intensive monitoring and research. If research results indicated that ecological conditions were improving after prescribed burns in certain habitat types, the size of prescribed burns in these habitat types could increase.

Similar to Alternative B, this alternative includes small pilot project burns in habitats where the ecological effects of burning are not fully understood. These include Douglas-fir stands, Bishop pine forests, coastal scrub, and some grassland habitats. The focus for prescribed burns under this alternative would be on areas where Seashore ecologists feel ecosystem health would be enhanced by burning and on areas where fuel accumulations create fire hazards. To the extent it is possible, prescribed burns would be conducted to approximate historic natural fire intensity and fire intervals. The intent is to allow the process of fire to act on the landscape as it has for thousands of years to the greatest extent possible, while ensuring human safety and protecting property. As with the other alternatives, Alternative C would also use prescribed fire to reduce infestations of highly invasive non-native plant species. Seashore personnel may time burns at unusual times of the year (spring, for example) to increase its effectiveness by killing young plants before they reproduce.

Prescribed burns could occur in any of the FMUs, with the exception of the Minimum Management Unit. The total acres burned within the Seashore, however, would never exceed 2,000 acres in any given year. The FMUs that would be subject to prescribed burning in Alternative C that are not burned in any other alternative include Tomales Point and Headlands. Most areas that would be subject to prescribed burning would be located within one mile of roads or major trails. The focus and intent of prescribed burns in each FMU are outlined below.

Tomales Point - The Tomales Point FMU supports a population of approximately 450 tule elk (N. Gates, personal communication) and a suite of 11 plant species of special concern (Table 3). No fire history data have been collected from the immediate vicinity of Tomales Point, but it can be inferred from fire history data collected elsewhere in the Seashore that this FMU has been subject to periodic fire through time. The plant species composition of the grasslands in this FMU includes a mixture of native and non-native grasses and herbs, with scattered patches of coastal scrub dominated by coyote brush (*Baccharis pilularis*) and lupine (*Lupinus arboreus*). Based on results of research conducted in other California grasslands, application of prescribed fire may encourage establishment of a larger proportion of native species than presently occur there. Small prescribed burns would be conducted in the Tomales Point FMU and would be carefully monitored to determine the response of the plant communities, including the plants of special concern, to fire. Additional benefits of fire in creating habitat and forage for tule elk and host plants for Myrtle's silverspot butterfly are also possible.

Studies would also be conducted on these burn units to determine the response of the invasive non-native velvet grass to prescribed burning at different times of the year. Velvet grass is a highly invasive, non-native, perennial, rhizomatous grass that has been increasing in aerial extent and density in many areas of the Seashore, and has been identified by the park's Exotic Plant Management Plan (NPS, 1989) as a priority for management.

Headlands - Prescribed burns have not been conducted in this FMU in the past. Although fire history data have not been collected in this area, it is unlikely that this area has historically

Figure 9. Map of Project Area Showing Alternative C FMUs

burned frequently due to the prevailing fog and moist conditions occurring most of the year. Small, prescribed burns would be applied in this FMU on a trial basis to determine if fire can be used to reduce the aerial extent and density of invasive non-native plants such as velvet grass, and to increase the percentage of native plant species in the headlands communities.

Estero – As in alternative B, prescribed burns would be conducted to contain and reduce the extent and density of the non-native plants Scotch broom, Monterey pine, Monterey cypress, and eucalyptus. Research would be conducted on the Scotch broom burn sites to determine the effects of prescribed burning on Scotch broom aerial extent and density.

Inverness Ridge - The same focus of treatment as described in Alternative B would apply to the use of prescribed burns in Inverness Ridge in this alternative. Initial burns would include small pilot projects in Bishop pine forest to determine if such burns effectively reduce understory biomass and dead and downed fuels, promote regeneration of rare species reliant on fire, and do not result in invasion by non-native plant species.

Limantour Road – Prescribed burning would be used to accomplish the same objectives in this FMU as described in Alternative B. These include reducing the density of Monterey pines, reducing hazardous fuel accumulations along the road corridor, and maintaining defensible space around buildings and visitor use areas.

Wilderness North - The initial burns in this FMU would be small pilot projects in Douglas-fir forest and grassland near Mt. Wittenberg. The primary objectives of these burns would be similar to, but more expanded than in Alternative B, and include:

- Reduce or break up the continuity of the very dense fuel loads occurring in many areas of the forest; thereby reducing the chance for adverse effects associated with an unplanned ignition (e.g., potential stand-replacing crown fire, loss of homes or other structures);

- Establish areas of reduced fuel loads where fire suppression crews could be staged in the event of a wildfire; and

- Reintroduce fire into forests that have historically burned on a regular basis (estimated fire return interval: 7-14 years), but which have not burned for 50-100 years.

If small burns effectively reduce understory biomass, larger burns may be conducted in this FMU in the future.

Wilderness South - The initial burns in this FMU would be small pilot projects in Douglas-fir forest and grassland near Firtop, and in Douglas-fir forest near Mud Lake. The primary objectives of these burns are identical to those described above for Wilderness North, and are similar to, but more expanded than those in Alternative B for this FMU. If small burns effectively reduce understory biomass, larger burns may be conducted in this FMU in the future.

Highway One – Prescribed burning would be used to achieve the same objectives in this FMU as under Alternative B. These include reducing grasses and other fuels along the highway corridor and the control of non-native French broom.

Bolinas Ridge – Prescribed burning would be used to achieve the same objectives in this FMU as under Alternative B. These include creating defensible space along the Sir Francis Drake Boulevard road corridor, reducing fuels, and managing Marin manzanita and Mason's ceanothus.

Palomarin – Prescribed burning would be used to achieve the same objectives in this FMU as under Alternative B. These include reductions of fuel and French broom, as well as control of Douglas-fir encroachment into coastal scrub habitats.

Mechanical Treatments

Implementation of Alternative C would result in an increase, when compared to either Alternative A or B, in acres subject to mechanical treatments to reduce hazardous fuel accumulations and to create and maintain defensible space and fuel breaks (i.e., the maximum number of acres that could be treated in any given year would increase from 500 acres to 1,500 acres). The Seashore would use mechanical treatments in the same FMUs as in Alternative B with the same objectives or focus for treatment, but mechanical cutting and thinning would take place on more acres. The FMUs that would receive mechanical treatment beyond clearing for fire roads and trails and around buildings to create defensible space are:

- Tomales Point
- Estero
- Inverness Ridge
- Limantour Road
- Wilderness North
- Wilderness South
- Highway One
- Palomarin

The treatments could occur in any of these FMUs, but the total acres treated within the Seashore would never exceed 1,500 acres in any given year. Some of the acres to be mechanically treated would be the same acres that are subject to prescribed burning (e.g., Scotch broom may be mowed prior to burning). The focus and intent of mechanical treatment in each FMU are outlined below.

Tomales Point – As in Alternative B, eucalyptus and Monterey cypress trees around Pierce Point Ranch would be subject to cutting and stump treatment with herbicides.

Estero – As in Alternative B, eucalyptus, Monterey pine, and Monterey cypress would be subject to cutting and stump treatment with herbicides. Scotch broom populations would be cut or mowed.

Inverness Ridge – The same actions as described in Alternative B for this FMU would take place in this alternative as well. These include the creation and maintenance of a 3-mile shaded fuel break along the ridge.

Limantour Road – The same actions as described in Alternative B, including trimming or removing trees along the road and cutting Monterey pine, would take place in this alternative.

Wilderness North – As in Alternative B, mechanical treatment would be used to thin forests prior to prescribed burning if test burns indicate burning can be conducted safely and enhances Douglas-fir in this FMU.

Wilderness South - As in Alternative B, mechanical treatment would be used to thin forests prior to prescribed burning if test burns indicate burning can be conducted safely and enhances Douglas-fir in this FMU.

Highway One – The actions described in Alternative B for this FMU would also be conducted in Alternative C. These include mowing grasslands along the highway and thinning or removal of eucalyptus.

Palomarin – As in Alternative B, Alternative C would include clearing of trees along roadways, mowing grasslands along the road, and cutting Douglas-fir encroaching into coastal scrub before these areas are burned.

Fire Effects and Fuels Management Research

Under Alternative C, the fire management program would be guided continually by the results of research on the ecological effects of fire and mechanical treatments. Ongoing research on Scotch broom, velvet grass, and rare chaparral plants would continue, and research on the effects of prescribed burning would expand into additional habitat types, including coastal grassland, Douglas-fir forest, riparian woodland, and Bishop pine forest. If the results of these studies are ecologically favorable (e.g., lead to increased native species richness, create areas supporting a variety of age classes within habitat types, and/or result in increases in rare species abundance or distribution), additional prescribed burning would occur in subsequent years in those habitat types.

Under this alternative, the research program also would be expanded to include studies on the effects of mechanical fuel treatments on ecological parameters. Vegetation would be selectively removed from within Douglas-fir forests and in shrub-dominated habitats such as coastal scrub and chaparral to determine the effects of such removal on physical and biological elements (e.g., soils, selected plant species). Specific research topics that could be included under this alternative include, but are not limited to, the following:

Tomales Point - the effects of prescribed burning on coastal grassland plant communities and wildlife species would be evaluated to determine if fire can be used to increase native species richness and density, to reduce density of velvet grass, and to increase the aerial extent and/or density of rare plants.

Headlands - the effects of prescribed burning on coastal grassland plant communities would be evaluated to determine if fire can be used to increase native species - both animal and plant - richness and density, and/or to reduce density and aerial extent of non-native species.

Inverness Ridge - the effects of prescribed burning on Bishop pine populations and associated plant and animal species within the Bishop pine community (including Marin manzanita and Mount Vision ceanothus) would be evaluated as in Alternative B; the effects of prescribed burning and mechanical treatments on dusky-footed woodrats, northern spotted owls, and Point Reyes mountain beavers would be assessed.

Limantour Road - the effects of prescribed burning on the highly invasive non-native Harding grass would be evaluated; the effects of prescribed burning on the rare plant fragrant fritillary (*Frittilaria liliaceae*) would be studied.

Wilderness North – the effects of prescribed burning on Douglas-fir forest communities, including spotted owl habitat elements would be evaluated; the effects of prescribed burning and mechanical treatments on dusky-footed woodrats would be assessed.

Wilderness South - the effects of prescribed burning on Douglas-fir forest communities, including spotted owl habitat elements would be evaluated; the effects of prescribed burning and mechanical treatments on dusky-footed woodrats would be assessed; the effects of prescribed burning and mechanical treatments on the rare plant Marin manzanita would be assessed.

Highway One – the effects of prescribed burning and mechanical treatments on creeks, riparian habitat, coho salmon and steelhead, and California freshwater shrimp would be assessed.

Bolinas Ridge - the effects of prescribed burning on coastal grassland and chaparral plant communities would be evaluated to determine if fire can be used to increase native species richness and/or density as in Alternative B.

Palomarin – the effectiveness of prescribed burning at reducing density or diversity of non-native plants would be assessed; the effects of prescribed burning and mechanical treatments on birds would be assessed in conjunction with the Point Reyes Bird Observatory as in Alternative B.

General Research - researchers would expand their studies of the effects of fire on plant communities and wildlife (G. Geupel, Point Reyes Bird Observatory, pers. com.; G. Fellers, USGS-BRD, pers. com.). Northern spotted owls, dusky-footed woodrats and land birds would continue to be specifically targeted for study of fire effects in order to meet compliance requirements under Endangered Species Act. Other topics that would be researched include: presence of sudden oak death, prescribed fire influence on the distribution of common ravens, and the spreading of native seeds after a prescribed fire.

Mitigation Measures

The following mitigation measures would be applied regardless of the alternative selected:

General

G-1. To ensure that implementation of fire management plan actions conforms to findings of this impact assessment, subsequent fire year plans and individual projects will be subject to NPS project review. Prior to approval, all projects will be submitted through an NPS internal review process wherein an interdisciplinary team will evaluate if the potential effects of the proposed projects are adequately addressed through the FMP NEPA process. Conformance to the conclusions in the FMP EIS will be documented for the NEPA record. If the team finds that the project has major new environmental effects not addressed in this EIS or effects greater than those described in this EIS, a separate environmental process will be conducted.

Soils

General

S-1. Individual burn plans will be written with enough detail to determine the extent of impacts to soil from erosion. Subject matter experts will determine if the erosion control plan submitted is sufficient to prevent long-term moderate or major impacts on the rate of soil erosion. In other words, the expert will determine if the proposed erosion control strategy will be sufficient to ensure no greater than minor impacts to soils from erosion. If the assessment finds that standard erosion control strategies will be insufficient to avoid long-term moderate or major effects on the rate of erosion, a separate NEPA process will be initiated for that burn plan. Strategies used to minimize impacts to soils can include avoiding steep slopes, timing burns to minimize erosion potential, or using erosion control devices during or after burns.

S-2. Watershed level planning will be used to assure that erosion rates within any one watershed will conform to the conclusions of environmental effect reached in this FEIS, (e.g., impacts will be no more than moderate in intensity). Watershed level planning will be triggered when proposed actions have potential to exceed 10% of the total area of one or more FMP watersheds in one year. This mitigation measure assures that planning considers the watershed scale, and if a potential effect is identified, that a specific assessment be conducted for the burn plan to assure the conformance of watershed level effects with this FEIS.

For Prescribed Burns

S-3. Some coarse, woody debris, if available, will be left on the site for nutrient cycling and mycorrhizal function.

S-4. All constructed fire lines will be rehabilitated to prevent compaction if needed.

For Mechanical Treatments

S-5. Mechanical regrading of roads will be conducted to specifications identified in the PRNS Trails Inventory and Condition Assessment and Road Memorandum of

Understanding with adjacent land management agencies. Use of these specifications will minimize erosion from fire roads.

S- 6. For FMP tree removal actions in areas with highly erosive soils or slopes over 15%, tree stumps will be left in place and cut as close to ground surface as feasible.

For Wildland Fire Control Activities

S-7. Following wildland fires, soil rehabilitation efforts will be focused on rehabilitating ground disturbance from heavy equipment.

S-8. Unless no feasible alternative is available, heavy equipment will not be used in areas where soils are wet or extensive compaction could occur. If staging of equipment or supplies occurs on soils, a clearly marked and visible limit of disturbance line will be installed using either stakes, flagging, or fencing. Surface soils in areas subjected to compaction will be scarified at the end of the period of use to retard runoff and promote revegetation.

S-9. Erosion control measures will be implemented where project actions could leave soils exposed to runoff prior to revegetation. Erosion control measures include covering exposed soils with weed-free chipped material, native duff, erosion control blankets, or certified sterile rice straw.

S-10. Where surface soils must be disturbed and soils support native vegetation, existing vegetation and topsoil will be retained and reinstalled whenever feasible.

Air Quality

A-1. If recommended by BAAQMD, prescribed burn plans submitted for review could be modified to reduce production of pollutants. Options include modifying burns to reduce the area burned, reducing fuel loading (e.g., mowing and understory thinning), or managing fuel consumption. Treatments to reduce overall air emissions from prescribed burns can include:

- Mowing grass and reducing density of vegetation in brushlands.
- Mechanical treatment of forested areas by removing standing or downed trees, understory thinning, thinning of forests, and creation of shaded firebreaks.
- More frequent, less intense burns to prevent unwanted vegetation from becoming established in clearings or in forest understory.

A-2. Increasing combustion efficiency or shifting the majority of combustion away from the smoldering phase and into the more efficient flaming phase will reduce emissions (except NOx, which is produced in greater quantities at higher temperatures). Methods to accomplish this will include pile or windrow burning, rapid mop-up, and shortened fire duration. Pile or windrow burning will generate more heat and burn more efficiently and be most effective in reducing forest fuel rather than brush type fuels.

A-3. The park will develop a Smoke Communication Strategy to guide management of smoke events during prescribed fires, managed wildland fires, suppression actions, and fires occurring outside the park. Notification of proposed burns will be disseminated through local media and postings to provide adequate advance notice to persons with sensitivities to smoke when burning is planned. Information will be provided to visitors, employees, and residents in smoke affected areas regarding health issues and concerns. The park will monitor particulate levels in the park during large smoke events to provide data for future assessments.

A-4. $PM_{2.5}$ monitoring data will be collected at Bear Valley in the Point Reyes National Seashore. Data collected will be shared with local, regional, and national air quality agencies and databases.

A-5. To reduce smoke and pollutant generation during late summer and early fall, efforts will be made to burn fuel concentrations, piles, landings, and jackpots outside of the prescribed burning season to increase the number of units that can be burned without overloading the airshed on days with good dispersal conditions.

A-6. To avoid impacts to visibility in the Class I PRNS portion of the project areas, burning will be avoided on holidays or other periods when recreational visitation is typically high.

A-7. To avoid public health and nuisance impacts to neighboring communities, prescribed burns will be conducted under meteorological conditions that will avoid smoke drift into sensitive residential areas and that will transport smoke away from populated areas. Planning for prescribed burning also will consider the smoldering period to avoid fires where downslope winds during the night could carry smoke into residential areas at the base of ridges.

Water Quality and Water Resources

W-1. Individual burn plans will be written with enough detail to determine the extent of erosion within the burn area due to a) the prescribed burn and/or, b) mechanical treatments. Subject matter experts will determine if the erosion control plan submitted is sufficient to prevent long-term moderate or major impacts to the water resources and water quality, and will assure project compliance with TDML implementation plans for Tomales Bay, Lagunitas Creek, and Walker Creek, according to availability through adoption by the EPA. Strategies to minimize erosion and sediment transport to water resources associated with prescribed burning include avoiding oversteep slopes, timing burns to minimize erosion potential, or using erosion control devices after burns. Strategies to minimize erosion and sediment transport to water resources associated with mechanical treatment include avoiding oversteep slopes, avoiding scraping or clearing to bare mineral soil (leave duff layer), or installing erosion control devices as part of mechanical treatment (if necessary).

W-2. Watershed level planning will be used to assure that prescribed burning and/or mechanical treatment within any one watershed will conform to the conclusions of the environmental effect reached in this EIS (e.g., the impacts will be no more than moderate in intensity). Watershed level planning will be triggered when proposed actions have the potential to exceed 10% of the total area of one or more FMU watersheds in one year. This mitigation measure assures that planning considers the watershed scale and, if a potential effect is identified that a specific assessment be conducted for the burn plan to assure the conformance of the watershed level effects within this EIS.

W-3. Helispots, staging areas, and spike camps will be located at least 100 feet away from streams, creeks, and other water bodies.

W-4. All fireline (both handline and dozer line) will be rehabilitated as quickly as possible, which will include application of Burned Area Emergency Rehabilitation (BAER) techniques such as recontouring, soil stabilization as needed, and monitoring for erosion and treatment as necessary in the first winter following disturbance.

W-5. When developing prescribed burn boundaries, non-treatment buffer areas will be established around perennial, intermittent, and ephemeral channels associated with Lagunitas Creek, Olema Creek, Pine Gulch Creek, and other coastal drainages originating from Inverness Ridge. Some treatment within buffer areas, including hand removal of non-native species and "cool" burns of non-native grasses, may occur within these areas. Fire lines around these areas will be mowed - not graded or scraped - in order to leave a 100-foot vegetated buffer strip from burn areas.

Vegetation

The following mitigation measures will be applied to reduce impacts from prescribed fire and mechanical treatment within all vegetation types:

V-1. "Pre"-Treatment Measures

- Individual prescribed burns will be conducted within the framework of a multidisciplinary planning effort. Personnel from fire management and from resource management will work together to identify areas that are expected to benefit from prescribed burning. Existing data on the response of plant communities in the Seashore to fire will be consolidated and analyzed to determine optimal areas, configurations, and times for burns. Clear objectives will be developed for prescribed burns that will include measurable parameters to determine the effects of the burns on vegetation. Following burns, vegetation will be analyzed to determine the effects of the burn, which will aid in future burn planning.

- Prescribed burns will be conducted at a time of year when introduction or spread of non-native plants will be minimized, and mortality of non-native plant species will be maximized.

- Whenever possible, existing roads or trails will be used as firebreaks for prescribed burns and for wildland fire suppression.

- Vegetation managers will work with fire management staff to develop maps of areas that support plant communities of special management concern (e.g., uncommon communities, wetlands, riparian areas, dunes, areas with no non-native plants that need to be kept intact, areas with highly invasive non-native plants that should not be spread) so fire personnel can attempt to avoid such areas when making decisions about fire management tactics.

V-2. "During" Treatment Measures

- Soil disturbance will be minimized to the greatest extent possible to reduce potential for introduction or spread of invasive non-native plant species.

- The aerial extent of disturbance associated with mechanical treatments will be kept to the minimum necessary to reduce fire risk.

- For helispots or spike camps, previously disturbed sites and open areas will be used whenever possible to minimize additional disturbance.

- Burn piles will be kept small to minimize the area disturbed and to allow for the recolonization of sterilized patches by mycorrhizal fungi and other soil organisms in adjacent areas.

V-3. "Post"-Treatment Measures

- Areas subject to fire management treatments will be monitored periodically for the presence of invasive non-native plant species, and if such species have established or spread as a result of such activities, the non-natives will be removed.

- All fireline (both handline and dozer line) will be rehabilitated as quickly as possible, which will include application of Burned Area Emergency Rehabilitation (BAER) techniques such as recontouring, soil stabilization as needed, and monitoring for and removal of invasive non-native plant species for a minimum of three years following a fire.

V-4. In grasslands

- Follow-up non-native plant monitoring and removal will be conducted to remove new recruits that come into the site in years following prescribed burning or mechanical treatments.

- All grassland burns will be carefully monitored to ensure burn objectives (= recruitment and long-term maintenance of native species without introduction of invasive non-native plant species) are being met.

- To enhance grassland plant species composition, and reduce the chance of invasion or spread of non-native species, native seeding trials will be conducted following fire management treatments in some areas.

- In Alternative C, small pilot burns (less than 100 acres) will be conducted in the Tomales Point FMU grassland to determine plant community response. These burns will be carefully monitored to ensure burn objectives (= recruitment and long-term maintenance of native species without introduction of invasive non-native plant species) are being met. If pilot projects determine objectives can be met using prescribed fire, individual burn size will increase to a maximum of 150 acres.

V-5. In Bishop pine

- Follow-up non-native plant monitoring and removal will be conducted to remove new recruits that come into the site in years following prescribed burning or mechanical treatments.

- Prescribed burning in Bishop pine stands will occur only if the burns can be conducted under conditions that will result in germination and recruitment of new stands of Bishop pine. Relatively cool fires under moist conditions may not meet this objective.

- Initially, prescribed burns in Bishop pine forest habitat will be small and will be carefully monitored to ensure burn objectives (= recruitment and long-term maintenance of Bishop pine and associated native species without introduction of invasive non-native plant species) are being met.

V-6. In Douglas-fir/coast redwood forests

- If pre-burn thinning of trees is required in forested stands, the trees to be thinned will be no larger than 10” in diameter.

- Prior to conducting prescribed burning in Douglas-fir or coast redwood forests, Seashore fire and vegetation managers, and wildlife and plant ecologists will collaborate to fully develop rationale, objectives, prescriptions, and plans for conducting burns in the redwood forests within the project area.

V-7. In hardwood forests

- Site-specific objectives will be developed for prescribed burns in hardwood forest habitat. The intent of such burns may be to reduce density or abundance of this vegetation type to encourage coastal scrub development, or may be to enhance the ecological health of the hardwood plant communities. Unique, site-specific burn prescriptions and timing will be required to meet these differing objectives.

V-8. In coastal scrub

- In coastal scrub small pilot burns (> 50 acres) will be conducted. These burns will be carefully monitored to ensure burn objectives (= recruitment and long-term maintenance of native species without introduction of invasive non-native plant species) are being met. If pilot projects determine objectives can be met using prescribed fire, individual burn size will increase to a maximum of 200 acres.

Wetlands

W-1. Burns will be allowed to back into and burn around wetlands and meadows or through them if the vegetation is dry enough to carry fire. Wetlands will be avoided to the greatest extent possible during fire confinement and containment.

W-2. Fire suppression activities will not occur in wetlands unless there are no alternatives available to control the spread of a wildland fire.

W-3. Fires near wetlands will be ignited when wetlands are too moist to sustain fire spread, thereby minimizing impacts to wetlands.

W-4. To the greatest extent possible, mechanical treatments will not occur in wetlands.

W-5. Wetlands may be used as natural boundary for prescribed fires. When a wetland area is being used as a boundary, the control line will occur in adjacent uplands, not in wetlands.

W-6. Prescribed fires will not occur more frequently than the time required for native plant species to set seed.

W-7. Foams or other fire retardants will not be used in or near wetlands.

W-8. Firebreaks or firelines will be constructed in previously disturbed areas whenever possible.

W-9. Chipped material will not be spread in wetlands.

Special Status Species

SS-1. Known populations of special-status plant and animal species will be monitored to ensure long-term impacts are avoided. Known populations of special status species will be avoided when locating helispots or spike camps.

SS-2. In Spotted Owl Habitat

- annually identify and map areas where spotted owls are nesting,
- protect occupied and previously used nest sites from unplanned ignitions,
- do not conduct prescribed burns within 400 meters of an occupied or previously used nest site,
- do not conduct mechanical treatments with mechanized equipment within 400 meters of an occupied or previously used nest site between February 1 and July 31 (breeding season),
- conduct post-treatment monitoring to ascertain any impacts.

SS-3. In Point Reyes Mountain Beaver Habitat

- identify and map areas known to support Point Reyes mountain beaver and areas that have habitat suitable for supporting Point Reyes mountain beaver,
- protect known and potential habitat from unplanned ignitions,
- establish buffer areas 30 feet wide around known habitat areas,
- conduct small burns (less than 100 acres) of mountain beaver habitat each year.

SS-4. Avoid conducting treatments during nesting season, March 15 through July 31, unless biologists can ascertain that birds are not nesting in the planned burn area.

SS-5. During the tule elk calving seasons, burns will be conducted in habitat away from areas where birthing and loafing of females and calves occur.

SS-6. To protect California red-legged frogs, areas to be treated by mechanical means or prescribed fire will have a buffer area of 30 feet established around known breeding habitat.

SS-7. The annual work plan for FMP implementation will be provided to NOAA Fisheries each year to allow that agency to monitor the types of projects proposed.

Cultural Resources

CR-1. Pre-Action

- Cultural resources will be considered during all fire management planning efforts.

- Fire management personnel and other staff will receive annual training on cultural resources and fire management actions.

- All cultural resources will be evaluated with respect to hazardous fuel loads. As needed, fuel loads will be reduced using methods commensurate with avoiding or minimizing adverse effects. Maintaining light fuel loads on and in close proximity to cultural resources will be emphasized. All areas slated for ground disturbing activities will be subjected to pre-action field surveys. This includes areas likely to be disturbed during future wildfires.

- Pre-burn survey will be conducted prior to all prescribed burns as dictated by resource distribution and vulnerability, vegetation and topography, and expected fire behavior.

- Consultation with local Native American communities will continue to occur in the context of fire management actions. Spiritual sites and important plant communities will be identified and appropriately managed for preservation, maintenance, and/or enhancement.

- Computer and other databases containing cultural resources data will be created and maintained, and made available to fire management personnel in the event of emergencies.

- Cultural resources specialists from adjacent land management agencies will be consulted in order to coordinate mitigation efforts prior to planned and unplanned fire management actions.

- Appropriate cultural resources monitoring protocols will be established and implemented.

- Potential research opportunities to study the effects of fire management actions on cultural resources will be identified.

CR-2. During-Action

- A cultural resource specialist or resource advisor will be present during all fire management actions where recorded and unrecorded resources of interest are considered at risk. Additional survey will be conducted on an as-needed basis.

- Observations of fire behavior and other variables will be made with respect to recorded cultural resources and/or areas with high probability of containing unrecorded cultural resources.

- Cultural resources data will be shared with fire management personnel as needed to avoid or minimize adverse effects.

- A cultural resource specialist or resource advisor will educate fire management personnel about cultural resources and the potential impacts of fire management actions.

CR-3. Post-Action

- The post-action condition of all recorded cultural resources will be assessed. Resources requiring stabilization or other treatment will be mitigated.

- As appropriate, post-action survey will be conducted in previously surveyed and unsurveyed areas. Previously unrecorded cultural resources will be assessed for condition, and stabilization and other protection needs.

- Monitoring and research data will be compiled, evaluated, and used to help refine cultural resource compliance for fire management actions.

Human Health and Safety

HH-1. Firefighters will be frequently rotated and allowed to rest or sleep when needed, and firelines and safety zones will be used to minimize exposure.

Alternatives Considered But Not Analyzed Further in This FEIS

Allow Wildland Fires to Burn without Human Intervention

This alternative was considered initially to determine the associated extent of impacts and resource benefits. Although wildland fire would result in substantial ecological benefits in many areas of the Seashore, the risk of significant adverse impacts to lives, property and resources would increase to an unacceptable level. In other words, meeting the FMP goal of protecting private and public property could not be guaranteed. Allowing uncontrolled burning also could violate a number of state and federal resource laws (e.g., Clean Air Act). For these reasons, this alternative was not analyzed further.

Apply Mechanical Treatments Only

The park uses mechanical treatments, including mowing, grazing and selective thinning, to remove hazardous fuels around buildings and along travel corridors. Use of these methods throughout the entire park is not possible due to federal laws (e.g., Wilderness Act) and unacceptable adverse impacts to natural resources. Much of the park that is not currently in the Pastoral Zone is rugged and without access. To mechanically treat these areas would require extensive labor and use of equipment incompatible with land use. Additionally, many of the species and ecosystems in the Seashore depend on periodic fire for their survival, and mechanical treatments cannot substitute for burning. For these reasons, this alternative was not analyzed further.

Create Wildland Fire Use Zone for Philip Burton Wilderness Area

This alternative was considered initially to meet objectives of the 1999 Resources Management Plan - to protect and perpetuate the diversity of natural ecosystems and to manage as wilderness those lands so designated. Upon further consideration, however, it was recognized that defensible boundaries to contain fires within the wilderness do not exist, and the risk of adverse impacts to lives, property and resources would be unacceptable. For these reasons, this alternative was not analyzed further.

The Environmentally Preferred Alternative

National Park Service policy regarding implementation of the National Environmental Policy Act (NEPA) requires that an environmentally preferred alternative be identified in all NEPA analysis documents. Determination of this alternative takes place after the environmental analysis is complete. The environmentally preferred alternative is the alternative that best promotes the national environmental policy expressed in Section 101 of NEPA. This includes alternatives that would:

- Fulfill the responsibilities of each generation as trustee of the environment for succeeding generations;
- Assure for all visitors a safe, healthful, productive, and aesthetically and culturally pleasing surroundings;
- Attain the widest range of beneficial uses of the environment without degradation, risk of health or safety, or other undesirable and unintended consequences;
- Preserve important historic, cultural and natural aspects of our national heritage and maintain, wherever possible, an environment which supports diversity and variety of individual choice;
- Achieve a balance of population and resource use which would permit high standards of living and a wide sharing of life's amenities; and
- Enhance the quality of renewable resources and approach the maximum attainable recycling of depletable resources.

Essentially, this means the environmentally preferred alternative is the one that causes the least damage to the biological and physical environment or most naturally perpetuates biological or physical process; it also means the alternative which is best suited to protect, preserve, and enhance historic, cultural and natural resources and process. After analyzing the alternatives described in this FEIS, the National Park Service has determined that Alternative C is environmentally preferred. Alternative C includes fire management treatments that would provide a high level of protection of human health, life and property, while maximizing efforts toward restoring and maintaining ecological integrity, and protecting and enhancing cultural resources (e.g., preserving important historic, cultural and natural aspects of our national heritage). Although Alternative B also would provide a high level of protection of life and property, it would not provide the same benefits to natural and cultural resources. Of the three alternatives, Alternative A (No Action) would provide the lowest degree of protection of lives and property, and minimal benefits to natural and cultural resources.

National Park Service policy also directs that all environmental analysis documents address compliance with Section 102(1) of NEPA. This section states that the policies, regulations, and public laws of the United States shall be interpreted and administered in accordance with the policies set forward in NEPA. This document was written in support of National Park Service

Fire Policy and other policies and legislation governing management of National Park sites in accordance with NEPA.

The Preferred Alternative

Alternative C has been selected as the alternative preferred by the National Park Service. The Superintendent has reviewed the FEIS and has evaluated the three alternatives with respect to how well they meet the fire program objectives, and their beneficial and adverse impacts on all resource topics (Table 5). Alternative C offers the best combination of benefits, with a high level of protection of life and property, and greater long and short-term natural and cultural resource benefits than either Alternatives A or B.

Table 5. Range of FMP Alternatives Compared by Fire Management Goals

Goals	**Alt. A**	**Alt. B**	**Alt. C**
Protect firefighters and the public	2	2	3
Protect private and public property	1	2	3
Maintain or improve conditions of natural resources and protect these resources from adverse impacts of wildland fire and fire management practices	2	2	3
Maximize efforts to protect cultural resources from adverse effects of wildland fire and fire management practices	2	3	3
Foster and maintain effective community and interagency fire management partnerships	3	3	3
Foster a high degree of understanding of fire and fuels management among park employees, neighbors, and visitors	2	3	3
Improve knowledge and understanding of fire through research and monitoring and continue to refine fire management practices	2	2	3

1 - Partially Meets Goal
2 –Meets Basic Level of Goal
3 –Provides Highest Levels of Goal Achievement

Table 6. Summary of Preferred Alternative and Alternatives

	Alternative A: No Action Continued Fuel Reduction for Public Safety and Limited Resource Enhancement	**Alternative B: Expanded Hazardous Fuel Reduction and Additional Natural Resource Enhancement**	**Alternative C: (Preferred) Increased Natural Resource Enhancement and Expanded Hazardous Fuel Reduction**
Prescribed Fire	500 acres would be treated annually with prescribed fire to reduce fuel loads.	1000 acres would be treated with prescribed fire to reduce fuel loads and conduct natural and cultural resource enhancement.	2,000 acres would be treated with prescribed fire to reduce fuel loads and conduct natural and cultural resource enhancement.
Mechanical Treatments	500 acres would be treated annually with mechanical means to reduce fuel loads.	1000 acres would be treated annually with mechanical means to reduce fuel loads and conduct resource management enhancement.	1,500 acres would be treated annually with mechanical means to reduce fuel loads and conduct resource management enhancement.
Fire Management Units Treated by Alternative	A total of four (4) FMUs would be treated. Prescribed Fire FMUs (4): Estero, Limantour Road, Highway One, and Bolinas Ridge. Mechanical treatment FMUs (3): Estero, Limantour Road, and Highway One.	A total of nine FMUs would be treated. Prescribed Fire FMUs (8): Estero, Inverness Ridge, Limantour Road, Wilderness North, Wilderness South, Highway One, Bolinas Ridge, and Palomarin. Mechanical treatment FMUs (8): Tomales Point, Estero, Inverness Ridge, Limantour Road, Wilderness North, Wilderness South, Highway One, and Palomarin.	A total of ten (10) FMUs would be treated. Prescribed Fire FMUs (10): Tomales Point, Headlands, Estero, Inverness Ridge, Limantour Road, Wilderness North, Wilderness South, Highway One, Bolinas Ridge, and Palomarin. Mechanical treatment FMUs (8): Tomales Point, Estero, Inverness Ridge, Limantour Road, Wilderness North, Wilderness South, Highway One, and Palomarin.
Total Acres in the FMUs to be Treated During Life of Plan (some acres may be treated more than once to ensure fuel reduction)	10,865	20,620	21,419
Wildfire Suppression	Current policy is to suppress all unplanned ignitions using minimum impact suppression tacks to the greatest extent possible.	Same as Alternative A	Same as Alternative A
Fire Education	A comprehensive program of information and education would be conducted to ensure public knowledge	Same as Alternative A.	Same as Alternative A.

	and understanding of prescribed burns and other treatments. NPS would work with local fire districts to encourage defensible space.		
Fire Cache Construction	A fire cache would be constructed at Bear Valley (park headquarters) to facilitate fire management program.	Same as Alternative A.	Same as Alternative A.
Fire Effects and Fuel Management Research	Fire effects program would continue and research on velvet grass and Scotch broom would continue.	Same as Alternative A.	Same as Alternative A, but expanded research on a variety of topics to guide expansion of resource enhancements projects.

Table 7. Summary of Impacts of Alternatives

	Alternative A: **No Action** **Continued Fuel Reduction for Public Safety and Limited Resource Enhancement**	**Alternative B:** **Expanded Hazardous Fuel Reduction and Additional Natural Resource Enhancement**	**Alternative C:** **Preferred** **Increased Natural Resource Enhancement and Expanded Hazardous Fuel Reduction**
Soils	Prescribed burning would result in negligible to minor increases in erosion and changes soil productivity and chemistry	Burn plans would be used to ensure increased erosion would affect no more than 10% of soils in a watershed; impacts would be no more than minor	Same as Alternative B
	Moderate to major short to long-term impacts to soils from a catastrophic wildland fire from erosion, hydrophobic soils, slope failure, suppression	Same as Alternative A	Same as Alternative A
	Negligible impacts to soils from their removal to build the fire cache would occur	Same as Alternative A	Same as Alternative A
Air Quality	Particulate emissions from all fire management activities would have a negligible long, term, adverse effect on regional haze.	Fire management activities would produce 2.86 pounds of particulates per acre—about twice that of Alternative A and a minor long-term, adverse impact to regional haze.	Fire management activities would produce 5.3 pounds of particulates per acre and a moderate, long-term adverse impact on regional haze
	The ongoing risk of a large wildfire and associated major adverse impacts to air quality would remain high.	Treatment would reduce the risk of a catastrophic wildfire and offer possible short-term major benefits to air quality as a result.	Same as Alternative B, although the risk of wildfire would be even lower.
	Negligible short-term impacts to air quality from the use of construction equipment to build the fire cache would occur.	Same as Alternative A	Same as Alternative A
Water Resources and Water Quality	Increases in erosion from hydrophobic soils, loss of vegetation and ash from prescribed burning would increase suspended solids, with negligible to minor impacts to water quality.	Same as Alternative A, although impacts would be more likely to be minor than negligible.	Same as Alternatives A and B, although impacts would be the most adverse of any alternative.
	Trampling and removal of vegetation from mechanical thinning or suppression of small wildfires could increase erosion and have negligible, localized short-term adverse impacts to water quality	Impacts would be minor.	Impacts would be minor and greater than Alternatives A or B.

	Large wildfires could have major adverse impacts on water quality and watershed from increased erosion and destruction of vegetation, including riparian vegetation.	Same as Alternative A	Same as Alternative A
	Treatment with mechanical thinning and prescribed burning would reduce the risk of catastrophic fire and have potential moderate benefits to watersheds and water quality.	Potential moderate to major benefits to watershed and water quality from a reduction in fuel loading and resulting decreased risk of catastrophic wildfire.	Same as Alternative B, although the benefits would be more likely to be major.
	No impacts to any water quality or watershed resource from building the fire cache would occur.	Same as Alternative A	Same as Alternative A
Vegetation	Minor, short-term impacts from the spread of non-native plants following prescribed fire are possible	Same as Alternative A	Same as Alternative A
	Minor to moderate beneficial impacts to native fire dependent vegetation from stimulating growth and killing non-native plants	Moderate benefits	Moderate benefits, but greater than Alternative B
	Crushing or shearing from mechanical equipment or trampling could have short-term minor adverse impacts	Same as Alternative A	Same as Alternative A
	Minor to moderate benefits from clearing dense vegetation through mechanical treatment	Moderate benefits	Moderate benefits, but greater than Alternative B
	Minor to moderate benefits would occur to native scrub and forest vegetation from removing Monterey pine and Monterey cypress trees	Same as Alternative A	Same as Alternative A
	Minor to moderate benefits to coastal scrub from the removal of scotch broom with prescribed fire and additional moderate to major benefits from removing scotch and french broom with mechanical treatment.	Moderate benefits from prescribed fire and major benefits from mechanical treatment.	Moderate benefits from prescribed fire, but greater than Alternative B; major benefits from mowing, but larger than Alternative B.
	No plans to burn in these FMUs to increase species richness	Minor benefits to coastal scrub from prescribed burning in Bolinas and Palomarin to increase species richness	Same as Alternative B
	Prescribed burning in grasslands may have minor adverse impacts or benefits, depending on reaction of native and non-native species	Same as Alternative A, although benefits or adverse impacts may be greater (they would remain minor)	Same as Alternative B, although benefits or adverse impacts may be greater (they would remain minor)
	Negligible benefits to hardwood, Douglas fir or Bishop pine forests from decreased fuel loads	Minor to moderate benefits	Moderate benefits

	No plans to aggressively treat in Douglas fir forest	Same as Alternative A	Possible major benefits to Douglas fir forests from returning natural fire intervals following treatment
	Cumulative impacts of catastrophic fire, historic logging, development and disease have been major, long-term and adverse. This would continue.	Same as Alternative A, although the risk of a catastrophic fire would decrease.	Same as Alternative B, although the risk of a catastrophic fire would decrease further.
	Negligible impacts to scrub, forest or grassland vegetation may occur from removing them to build the fire cache, although the cache is to be located in an area that is already disturbed.	Same as Alternative A	Same as Alternative A
Wetlands	Short-term minor adverse impacts from inadvertent burning to non-adapted wetland vegetation during prescribed burns.	Same as Alternative A	Same as Alternative A
	Minor to moderate short to long-term benefits from inadvertent burning of adapted wetland vegetation or of exotics in wetlands from prescribed fire possible	Same as Alternative A	Same as alternative A, although more likely to be moderate than minor
	Minor short-term adverse impacts from suppression of average sized wildfires, and minor positive or negative impacts to vegetation from fires.	Same as Alternative A	Same as Alternative A
	Mechanical treatment in wetlands usually avoided; however if needed it may have negligible to minor short-term adverse impacts from trampling, or minor benefits from clearing exotics	Same as Alternative A, although adverse impacts more likely to be minor.	Same as Alternative B, although adverse impacts could be greater.
	Cumulative impacts from development and catastrophic fire could have major, long-term adverse impacts from destruction of vegetation, invasion of exotic species	Same as Alternative A	Same as Alternative A
	No wetlands would be disturbed or removed in building the fire cache.	Same as Alternative A	Same as Alternative A
Wildlife	Fire management activities would have a minor short or long-term benefit by creating more open wildlife habitat and reducing the risk of catastrophic fire	Moderate benefits compared to Alternative A	Moderate to major benefits compared to Alternative A
	Minor short-term impacts from suppression of average sized wildfires would continue.	Impacts would remain minor, but be greater than Alternative A	Impacts would remain minor, but be greater than all alternatives
	Minor adverse impact to forest dwelling species from treatment	Minor to moderate impacts compared to Alternative A	Minor to moderate impacts compared to Alternative A
	Cumulative impacts of development, habitat alteration and a catastrophic fire, should it occur, would all have major, long or short-term adverse impacts on wildlife.	Same as Alternative A	Same as Alternative A

	Short-term, minor adverse impacts on wildlife in the vicinity of the planned fire cache could occur during construction from noise and the presence of humans	Same as Alternative A	Same as Alternative A
Special Status Species	No federally listed plants would be affected, as all known populations lie in the Minimum Management Zone, where treated is not planned.	Same as Alternative A	Same as Alternative A
	Plant species of concern would likely continue to experience minor landscape scale benefits from fire management activities	Benefits would increase, but remain minor	Benefits would be the greatest of the alternatives, but remain minor
	Plant species of concern may experience minor adverse effects from destruction, or inadvertent stimulation of exotic species during prescribed burns	Same as Alternative A	Same as Alternative A
Spotted owls, red-legged frogs, California freshwater shrimp	Treatment would offer negligible to minor, long-term benefits to northern spotted owls, red-legged frogs and California freshwater shrimp from a reduction in the risk of catastrophic fire	Minor benefits	Moderate benefits
	Hand thinning and pile burning could have minor short-term effects to spotted owls from disturbance, and on red legged frogs from inadvertently crushing them	Same as Alternative A	Same as Alternative A
	Cumulative effects of a large-scale wildfire would be long-term, major and adverse on spotted owls and red-legged frogs	Same as Alternative A	Same as Alternative A
Coho salmon and steelhead trout	Fire management would not normally take place in riparian vegetation, so impacts to coho salmon and steelhead trout would be inadvertent, and remain negligible to minor.	Same as Alternative A	Same as Alternative A
	Negligible positive benefits to coho and steelhead from reducing the risk and intensity of a catastrophic fire	Same as Alternative A	Same as Alternative A
	Siltation of streams and loss of riparian vegetation would have minor to major impacts	Same as Alternative A	Same as Alternative A
Myrtle's silverspot butterfly and snowy plovers	Myrtle's silverspot butterfly and snowy plovers occur in the Minimum Management Unit, where fire management activities are not anticipated. No impact from the FMP would occur	Same as Alternative A	Same as Alternative A
Pt. Reyes Mountain Beaver	Minor impacts to Point Reyes mountain beaver from fire management activities, including suppression of average sized wildfires would occur	Same as Alternative A	Same as Alternative A
	Large-scale wildfires could have short to long-term moderate to major adverse impacts from habitat destruction, and direct and indirect killing of animals	Same as Alternative A	Same as Alternative A
	No impact to any listed plant or animal species would occur from construction of	Same as Alternative A	Same as Alternative A

	the fire cache		
Cultural Resources	Moderate benefits to historic buildings by reducing fuel building through fire management activities would occur	Benefits would remain moderate, but be greater than in Alternative A	Benefits would remain moderate, but be the greatest of any alternative
	Minor adverse impacts from ground disturbance associated with pre-treatment or mechanical thinning could occur	Impacts would remain minor, but be greater than in Alternative A	Moderate
	Moderate long-term benefits to cultural landscapes from the use of prescribed burning or mechanical treatment possible	Benefits would remain moderate, but be greater than in Alternative A	Benefits would remain moderate, but be the greatest of any alternative
	Suppression of average sized wildfires or of larger wildfires could have unknown negligible to major, permanent adverse impacts to cultural resources. Large wildfires could also destroy cultural resources.	Same as Alternative A	Same as Alternative A
	No impacts from construction of the fire cache are anticipated	Same as Alternative A	Same as Alternative A
Visitor Use and Visitor Experience	Minor positive impacts from prescribed fire on visitor experience by opening scenic vistas	Same as Alternative A	Same as Alternative A
	Minor adverse effects on visitors from the site of blackened vegetation from prescribed burning	Same as Alternative A	Moderate impact on visitors possible
	Minor impact on visitor use from closures during prescribed burn	Impact is greater than Alternative A, but remains minor (up to 30 days/year)	Moderate impact of up to 50 days of closures
	Minor impact to visitor use and experience from closures and noise during mechanical treatment.	Impact is greater than Alternative A, but remains minor	Moderate impact possible
	Minor short-term adverse impact to visitors from noise and dust associated with construction of fire cache	Same as Alternative A	Same as Alternative A
	Major, short to long-term adverse impacts on visitor use and visitor experience possible from large-scale wildfire	Same as Alternative A	Same as Alternative A
Park Operations	Fire management operations require 13 staff and account for about 15% of the park budget	A 3.8% increase in funding and staffing would be required, a minor impact	A 5.9% increase in funding and staff would be required, a minor impact
	Funding the fire cache would have a short-term negligible adverse impact on the park's budget, but would have long-term minor benefits in terms of increased staff efficiency.	Same as Alternative A	Same as Alternative A
	Suppression of a large-scale wildfire would have short-term, major adverse impacts on park operations, management and budget	Same as Alternative A	Same as Alternative A

Public Health and Safety	Impacts from prescribed burning and mechanical thinning on human health and safety, including the public and firefighters would be short-term and minor.	Same as Alternative A	Same as Alternative A
	Large, severe wildfires could have major adverse effects on the risk and impacts from smoke or fire to public and firefighter health and safety	Same as Alternative A	Same as Alternative A
	Negligible benefits from the reduction in risk or intensity of a large wildfire	Moderate benefits	Moderate benefits
	Completion of the fire cache would have minor benefits in increasing efficiency of response	Same as Alternative A	Same as Alternative A
Socio-economics	Minor benefits to the local economy from fire management program and staff spending	Same as Alternative A	Moderate benefits
	No or negligible impacts on local economy from loss of tourist dollars during closures from prescribed burning	Impacts would remain negligible, but be greater than Alternative A	Impacts would remain negligible, but be the greatest of all alternatives
	Negligible to minor impacts on local economy from loss of tourist dollars during closures from mechanical treatment	Impacts would remain negligible, but be greater than Alternative A	Impacts would remain negligible, but be the greatest of all alternatives
	Negligible, short-term impacts to the local economy from loss of tourist dollars during closures for suppression of average sized wildfires	Same as Alternative A	Same as Alternative A
	A large wildfire could have major, short to long-term adverse impacts on the local economy, loss of property, but possible major benefits from increases in local spending from suppression program needs and personnel	Same as Alternative A	Same as Alternative A

CHAPTER 3: AFFECTED ENVIRONMENT

INTRODUCTION

This chapter provides an understanding of both the general environmental setting of the project area and a more focused description of those resources that could be affected by the implementation of the FMP alternatives. The first section, Project Setting, is presented to foster a fuller understanding of the scope of the FMP. The Affected Environment is required (by the Council on Environmental Quality NEPA regulations, Sec. 1502.15) to succinctly describe the environment of the area(s) likely to be affected by the alternatives under consideration, and focus efforts and attention on important issues. Scoping determined that the areas of the environment that could be affected by the FMP are soil resources, air quality, water quality, vegetation, wildlife, cultural resources, park visitor experience, park operations and socioeconomics.

PROJECT SETTING

Overview

The project area is located in central California, in western Marin County, approximately 40 miles northwest of the city of San Francisco (see Figure 1 and Figure 2). It is comprised of federal lands managed by the Point Reyes National Seashore, a unit of the National Park System, and is within 50 miles of the nine-county San Francisco Bay Area, the 5th largest metropolitan area in the United States (see Figure 10).

Generally, the more developed regions of the bay area surround the bay itself, with smaller cities, towns, open space and agricultural areas in an outer ring around the urban core. Forty-eight percent (159,044 acres) of the 332,800 acres in Marin County is held as parks, open space and watershed (Marin County Community Development Agency 2002). Thirty-six percent (119,808 acres) is in agricultural use. Developed lands constitute only 11% of the county while 5% of the county has future development potential.

While eastern Marin is heavily developed along the Highway 101 corridor, western Marin is primarily rural with scattered small unincorporated towns that serve agriculture, local residents and tourism. Roughly 90% of the quarter of a million residents of Marin County live in the eastern half of the County along the major transportation corridor -- State Highway 101.

Figure 10. Population Density for San Francisco Bay Area in 1990

Regional Context and Surrounding Communities

The project area consists of 90,311 acres of the Point Reyes National Seashore (PRNS) and the northern lands of Golden Gate National Recreation Area (GGNRA). The total project area includes 86 miles of shoreline on both the Pacific Ocean and Tomales Bay. The 71,046-acre Seashore includes beaches, coastal cliffs and headlands, marine terraces, coastal uplands, woodlands, and forests on the Point Reyes Peninsula.

PRNS is bounded to the north, west and southwest by the Pacific Ocean and to the east by the residential communities of Inverness, Inverness Park, Point Reyes Station, Olema, and Dogtown. The town of Bolinas is south of PRNS at the southern tip of the Peninsula (see Figure 11). An estimated 3,800 permanent residents live in the towns and communities close to the project area from the tip of Tomales Bay in the north to Stinson Beach in the south (US Census Bureau 2000). The census population figure does not count the many part-time residents of western Marin who maintain second homes in the project area.

Through a memorandum of agreement between the two national parks, PRNS manages the 19,265 acres of Bolinas Ridge for GGNRA. Bolinas Ridge is a northwest/southeast trending ridge paralleling the Olema Valley and the San Andreas fault zone. The northwest-facing slope of the Ridge is primarily grassland and shrub with east facing slopes forested with Douglas-fir and coast redwood.

East of the project area, land use is a mix of private residential and agricultural lands, publicly held watershed, and parks and open space. Adjacent to the park are areas managed by Audubon Canyon Ranch, Marin Municipal Water District, Tomales Bay and Samuel P. Taylor State Parks, and Marin County Open Space District (MCOSD) lands. Marine boundaries are shared with the Gulf of the Farallones and the Cordell Banks National Marine Sanctuaries, and Tomales Bay State Park. Some agricultural parcels are part of the Marin Agricultural Land Trust to which the owners have deeded development rights to protect rural agriculture from development pressures.

Park Management Zoning

PRNS and GGNRA share a general management plan (NPS, 1980), which uses the following zoning designations (see Figure 12) to guide park management. Prescribed fire and other fuel management strategies could be used to help achieve the desired future conditions described for some or all of these zones.

Project area lands fall under one of two management zones: Natural Resource Zone or Historic Resource Zone. The Natural Resource Zone covers pastoral lands, natural landscape areas, sensitive resources, designated wilderness and marine reserves. Historic ranches, the Point Reyes lighthouse and the lifesaving station are included in the Historic Resource Zone. A third zone called Special Use Zone exists within the boundaries of PRNS and GGNRA, but is not applicable to fire management. These lands are managed by another entity such as Mt. Tamalpais State Park and Audubon Canyon Ranch.

Figure 11. Local Communities

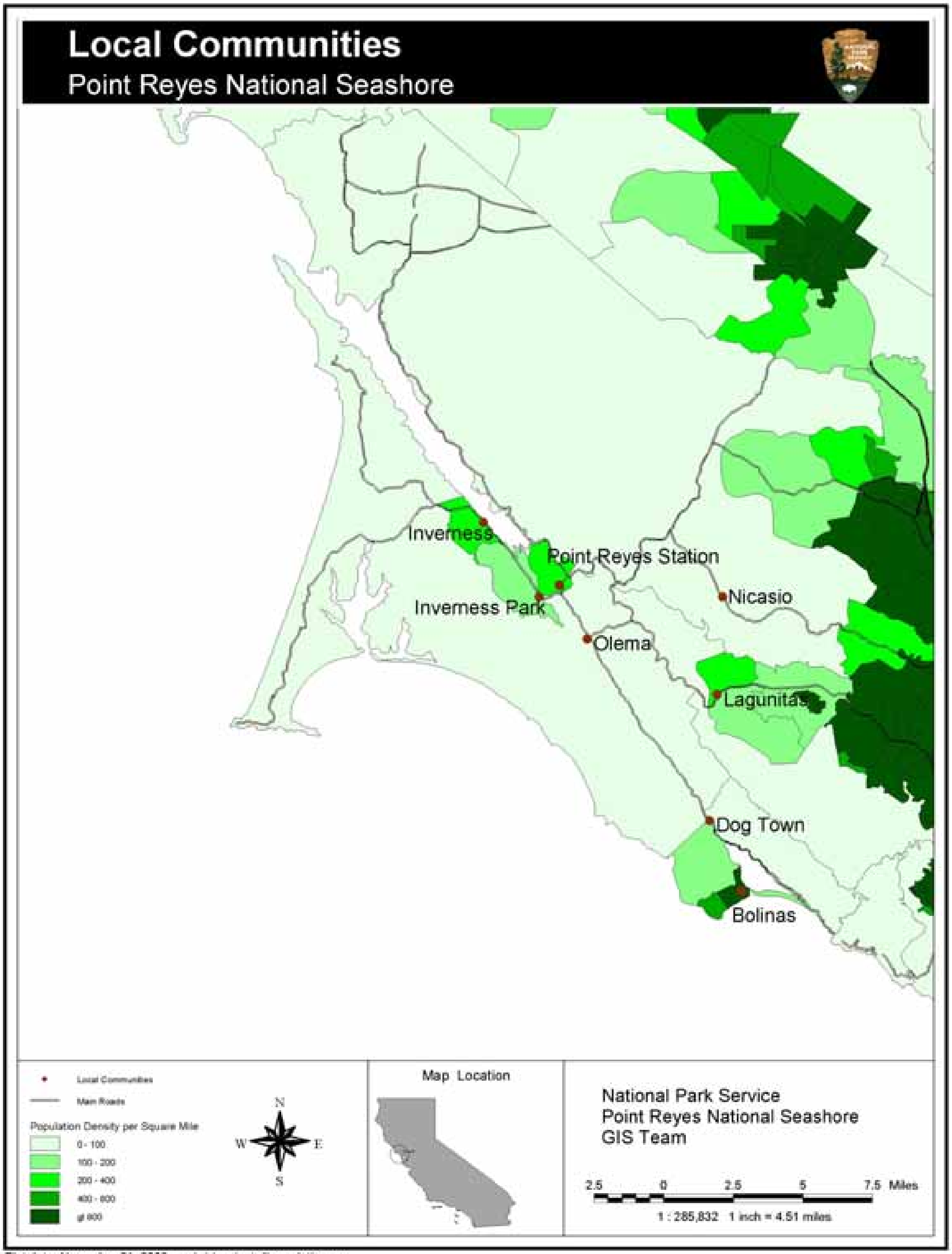


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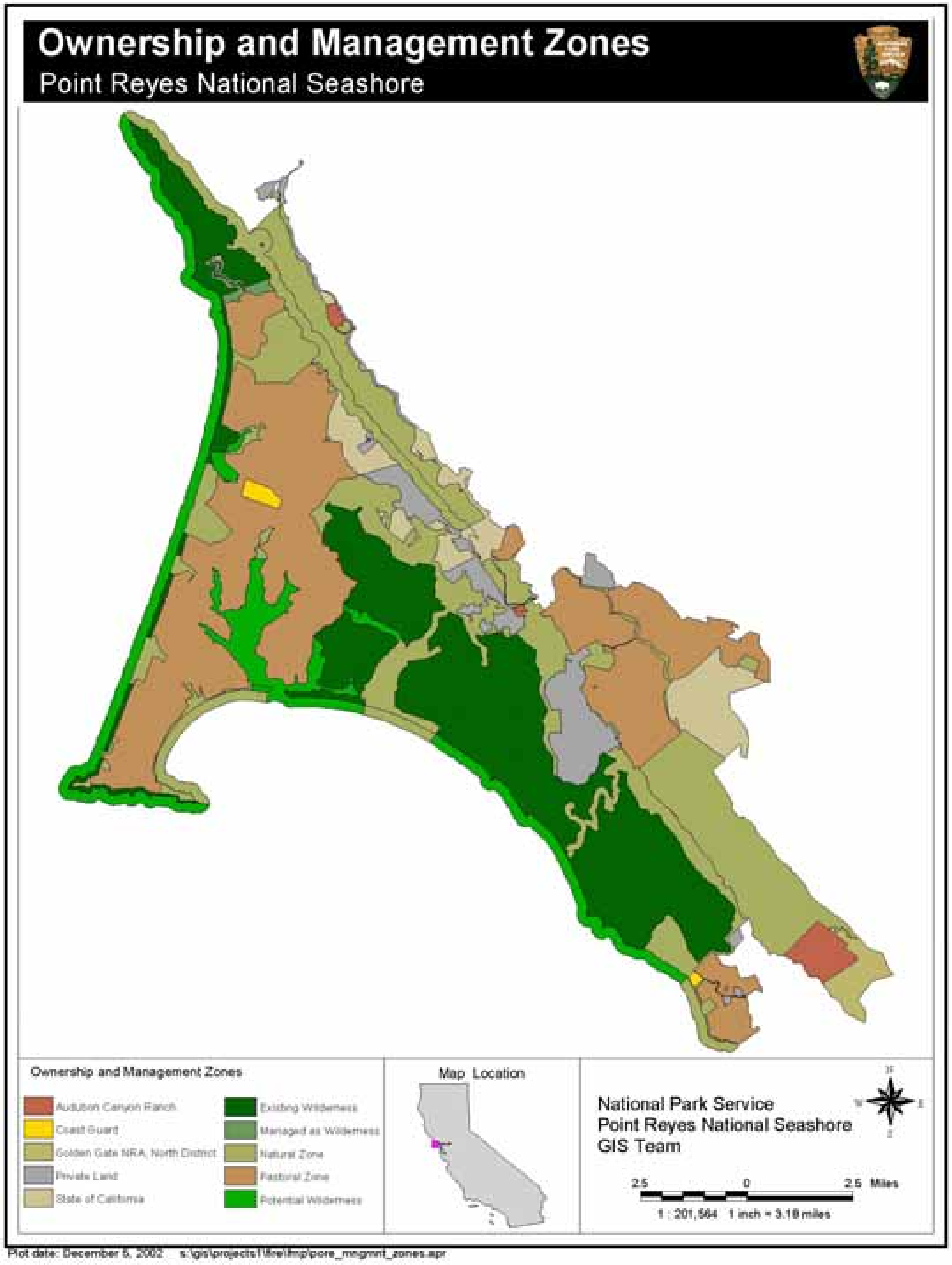
Figure 12. Point Reyes National Seashore Ownership and Management Zones



Natural Resource Zones

Pastoral Landscape Management Zone (northern Olema Valley and northern Point Reyes peninsula). Approximately 19,000 acres of PRNS have been retained in agricultural production within the pastoral zone that supports beef and dairy production. The Northern District of GGNRA contains an additional 10,500 acres leased for cattle grazing. Pastoral operations presently include seven dairy and ten beef cattle ranches. The GMP indicates that, at a minimum, agricultural buildings and open grasslands will be retained in these areas, and where feasible, livestock grazing will continue within the limits of carefully monitored range capacities (NPS, 1980, p. 18), and that future resource management studies could significantly alter the configuration of this zone. To help in carrying out these policies, the FMP may include small pilot projects within the pastoral lands geared towards techniques for the control of invasive exotic plant species such as Scotch and French broom and the maintenance of high-quality pasture for cattle grazing. The Estero and Headlands FMUs, the northern end of the Bolinas Ridge FMU and the southern end of the Palomarin FMU are in the Pastoral Landscape Management Zone.

Natural Landscape Management Zone (southern Olema Valley and Bolinas Ridge, Limantour Road corridor and Limantour Beach, Tomales Bay shoreline north of the State Park, Bear Valley, recreational beaches, road corridors and select trail corridors). The Natural Landscape Management Zone applies to those lands containing important natural resources that are not within the designated wilderness of PRNS. The largest track is the southern half of the Bolinas Ridge, lands buffering Limantour Road and Limantour Beach and the Marshall Beach area north of Tomales Bay State Park. GMP direction for these areas is that natural resources and processes remain as undisturbed as possible given a relatively high level of park use (NPS, 1980, p. 18). The Olema Valley is to be managed to maintain the visual contrast between woodland and open grassland. (NPS, 1980, p. 96). Fire management strategies such as selective thinning, burning and mowing would be cautiously pursued in this zone with the objective of protecting scenic, ecological and recreational values. The Inverness Ridge, Limantour and Palomarin FMUs are within this zone as are the road corridors of the Wilderness North and South FMUs.

Special Protection Zone (Philip Burton Wilderness Area. Gulf of the Farallones National Marine Sanctuary, State of California Marine Reserves, shorelines and riparian corridors). Special Protection Zones includes lands that have received legislative or special administrative recognition of exceptional natural qualities requiring strict protection measures.

Wilderness Subzone. Public Law 94-567 designated more than half of PRNS as the 32,373-acre Philip Burton Wilderness Area, part of the National Wilderness Preservation System. As directed in NPS 2001 Management Policies (2000), fire management activities in wilderness areas must:

- Conform to the basic purposes of wilderness,
- Provide for the identification and reconciliation of the natural and historic roles of fire in the wilderness, and
- Identify a prescription for response to natural and human-caused wildfires in the wilderness area. (NPS, 2000, section 6.3.9)

The Management Policies also state that suppression strategies for wildland fire in wilderness areas must use the “minimum requirement” concept, a process of identifying the least damaging tools or activities, to protect natural and cultural resources and minimize any lasting impacts of the suppression actions. The Tomales Point, North Wilderness, South Wilderness, Limantour, Highway One, Palomarin and Inverness Ridge FMUs contain designated wilderness lands.

Marine Reserves Subzone. Marine reserves were established at the Point Reyes Headlands, Limantour Estero (Estero de Limantour) and Duxbury Reef Reserve (adjacent to PRNS’s southern boundary) in 1972 by the California Department of Fish and Game under Title 14 of the California Code. The purpose of the reserves is to preserve them in a natural condition and to protect the aquatic organisms and wildlife found thereon for public observation and scientific study. Management of the Headlands Reserve prohibits recreational fishing and places restrictions on commercial fishing. Commercial and recreational fishing and collecting are prohibited in the Estero de Limantour Reserve. The NPS maintains a standing proposal to the State to grant Research Natural Area status to the Double Point and Bird Rock areas of Point Reyes. The FMP must provide adequate protections for the marine reserve subzone areas from direct and indirect effects of plan implementation. The Headlands FMU, Limantour Road FMU, Tomales Point FMU, and Estero FMU border these marine reserves.

Biotic Sensitivity Subzone. This subzone includes natural resources in the park that are particularly sensitive to human use or are especially valuable from an ecological or scientific point of view. Most of the areas covered by this subzone are watercourses or bodies of water recognized for their importance in sustaining wildlife and vegetation. The GMP states that use and development in these areas will be either discouraged or mitigated sufficiently to avoid significant levels of deterioration. The FMP must provide sufficient safeguards during implementation to protect this resource subzone from degradation and provide enhancement wherever possible. Potential beneficial and adverse effects on riparian areas and water resources are addressed in this EIS under the headings of water quality and vegetation in the Environmental Consequences Chapter. The Estero, Highway One and Palomarin FMUs contain lands with this designation.

Historic Resource Zones

Preservation Zone (including the Point Reyes Lighthouses and Lifeboat Station). Spaces and objects in this category primarily are managed and used for facilitating public enjoyment, understanding, and appreciation of their historic values. Since the adoption of the 1980 GMP, many of the historic structures in the park have been adaptively re-used under the agricultural leases. Others house visitor activities and associations, park administrative offices or provide housing for park employees. The GMP indicates these historic resources be protected from damage and deterioration, and the FMP includes actions such as roadside mowing and maintenance of defensible space around them to provide protection should an unplanned ignition occur.

Geology and Topography

The character of the Point Reyes Peninsula has been shaped and remains defined by its association with the San Andreas Fault System. The San Andreas Fault Zone (SAFZ) forms the active tectonic boundary between the Pacific plate and the continental North American plate.

Clark and Brabb (1997) describe similarities between Eocene and Miocene depositional sequences of the Point Reyes and Monterey peninsulas suggesting displacement of the Point Reyes Peninsula along the San Gregorio Fault of as much as 150 km (94 mi) in the last 11 million years. Recent research on the San Andreas Fault has allowed researchers to document the occurrence of 10 additional large-scale land movement events in the past 2,500 year, with a recurrence interval on the order of one major event every 250 years (Zhang et al., 2003). Due to different rock types, the geomorphology, hydrology, weather, soils, and plant communities east of the fault differ in many ways from that of the peninsula.

Salinian granite underlies nearly the entire peninsula, and is exposed in the areas of Inverness Ridge, Tomales Point, and the Point Reyes Headlands (see Figure 13). The granite is unconformably overlain by the Monterey Shale in the southern part of the peninsula which is exposed along the coastline from Drakes Bay south to Bolinas (Konigsmark, 1998). Coastal wavecut benches and flooded valleys are the result of sea level fluctuations during the Pleistocene and Quaternary tectonic uplift (Scherer and Grove, 2003). The Point Reyes plain, extending from Inverness Ridge west to the headlands is underlain by siltstone and mudstone of the Purisima Formation (Clark & Brabb, 1997), which also occurs in the Santa Cruz Mountains. The headlands present the most unique exposed formation within the park, the Point Reyes Conglomerate, a sandstone conglomerate with rounded chert, volcanic, and granitic cobbles. It is best exposed along the Lighthouse steps and is most similar to a conglomerate that occurs on Point Lobos, 100 miles to the south (Evens, 1993).

The Olema Valley, extending from Bolinas Lagoon to Tomales Bay is representative of the SAFZ. The Valley ranges in width from 1,500 to 7,000 feet. The Olema Valley includes a variety of fault-associated topographic features including linear ridges and drainage patterns, parallel stream systems, offset rows of trees and fences, and a series of sag ponds. The surface rupture caused by the 1906 earthquake extended from Bolinas Lagoon to Tomales Bay, with lateral displacement ranging from 14 to 20 feet in the Olema Valley (Gilbert, 1908).

Bedrock east of the fault (generally east of Highway 1) is the Franciscan Complex that makes up much of California's Coast Range. The Franciscan Complex is believed to be a fossil accretionary wedge of sediment that used to fill the trench of a subduction zone. It is mostly composed of greywacke, sandstone and shale with different grades of metamorphosis. Some parts of the Franciscan Complex are a mélange, including highly metamorphosed, low-grade mudstone, siltstone, and sandstone with occasional inclusions of limestone, chert, serpentinite, eclogite, and amphibolite conglomerate (Galloway, 1977). The Franciscan Complex is highly unstable and is known for slope instability, thin soils, and high runoff rates.

The topography within the project area is controlled by Inverness and Bolinas Ridge and the dominant San Andreas Fault. Watersheds draining from Inverness Ridge are perennial while those draining from Bolinas Ridge are nearly always intermittent. Most of the watersheds within the Olema Valley have drastically altered and unusual drainage patterns associated with the combination of stream capture and alterations to the topography caused by the strike-slip movement of the San Andreas Fault. Near their headwaters, Olema Creek and Pine Gulch Creek run parallel, but in opposite directions for nearly two miles. Near the head of Tomales Bay, Bear Valley Creek drains at an acute angle from Inverness Ridge (likely stream capture) and makes an abrupt turn to the north adjacent to the 1906 fault rupture, running parallel to Olema Creek until they discharge into the Lagunitas Creek estuary.

Inverness Ridge forms the backbone of the Point Reyes Peninsula, reaching a height of 1,407 feet at Mount Wittenberg. The ridge is characterized by relatively consistent upland elevation with overly steep headwater stream systems. The only interruption in the ridge between Bolinas and Tomales Point is the 400-foot pass at Divide Meadow. The soils of the Monterey Shale and Purisima Formation have high rates of infiltration, allowing Inverness Ridge to support most of the perennial streams within PRNS. South of Laguna Creek, Inverness Ridge merges with the Bolinas Mesa, a wave-cut bench into Monterey Shale. The terrace is intersected by a number of steep ravines formed by actively downcutting stream channels. Some of the most spectacular landmarks in PRNS, including Arch Rock and Alamere Falls are a result of this interaction between small streams and bedrock along the rocky coastline.

Bolinas Ridge to the east rises approximately 800 feet in elevations. The soil type, lithology, and climate combine resulting in far drier conditions on the west facing slopes. The ridge is primarily grassland with the steep, narrow ravines dominated by oak, bay laurel, and Douglas fir.

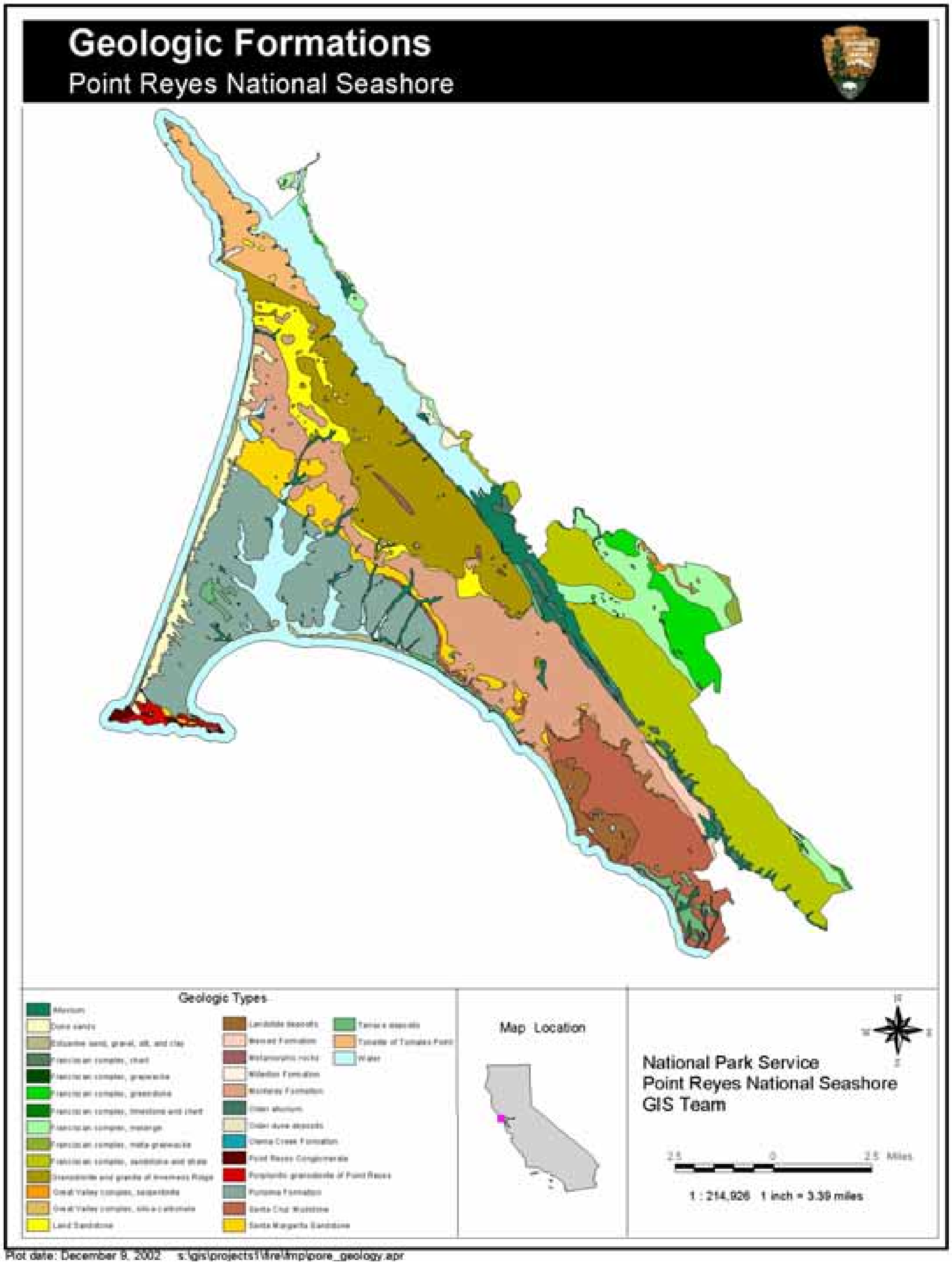
Inverness Ridge forms the backbone of the Point Reyes Peninsula, reaching a height of 1,407 feet at Mount Wittenberg. The ridge is characterized by relatively consistent upland elevation with sharp precipices dropping down into the river valleys. The only interruption in the ridge, between Bolinas and Tomales Point is the 400-foot pass between Bear Valley and Coast Creek drainages. Most of the perennial streams within PRNS originate from the ridge. South of Laguna Creek, the ridge merges with the Bolinas Mesa, an uplifted, wave-cut Monterey Shale bench. This terrace is intersected by a number of steep ravines caused by drainages cut down to current sea level. Some of the most spectacular landmarks in PRNS, including Arch Rock and Alamere Falls, are on this terrace.

Bolinas Ridge to the east rises to approximately 800 feet in elevation. Due to soil type and climate, conditions are far drier on these west-facing slopes. Ridges are primarily grasslands with the steep tributary valleys dominated by oak and bay laurel.

Fire Regime

The term “fire regime” refers to a simplified description of characteristics of the fires that typically occur at a given site. Present fire regimes often differ from historic fire regimes. Descriptions of fire regimes are general and broad because of the enormous variability of fire over time and space (Whalen, 1995). The factors that are often used to determine and describe fire regimes in an area include fire type, intensity, extent or size, frequency, and/or season (Whalen, 1995, Brown, 2000).

Figure 13. Point Reyes National Seashore Geologic Formations



It is likely that prior to Euro-American settlement of the project area in the mid-1800s, forest and woodland plant communities were subject to a mixed severity fire regime, which can arise in one of three ways (Brown, 2000):

> Many trees are killed by mostly surface fire but many survive, usually survivors include fire-resistant species of relatively large size.
>
> Severity within individual fires varies between understory burning and stand-replacement, which creates a fine-grained pattern of young and older trees. This type of regime probably is due to fluctuations in weather during fires, diurnal changes in burning conditions, and variation in topography, fuels, and stand structure within burns. Highly dissected terrain is conducive to this fire regime.
>
> Fire severity varies over time with individual fires alternating between understory burns and stand-replacement. This regime has also been termed "variable" and has been applied to redwood forests.

Prior to Euro-American settlement, shrub-dominated or grassland plant communities in the project area may have been influenced by a stand-replacing fire regime, as most fires likely killed or removed most of the aboveground vegetation. The variability in topography, fuels, and diurnal weather fluctuations, however, could have resulted in a mixed severity fire regime, as described above for forests and woodlands.

The current fire regime for the Point Reyes area has changed dramatically since the mid-1800s as a result of Euro-American settlement patterns and practices. Effective fire suppression has resulted in large accumulations of fuels in many forest, woodland, and shrub-dominated plant communities. Thus, when fires do burn, they often are stand-replacing, as evidenced by many areas within the perimeter of the 1995 Vision Fire.

Following the cessation of winter rains in mid-April, fuels dry rapidly and the light fuels of the annual grassland (2,000-7,000 lbs/acre) cure. During the summer months, live, dead and downed round wood material and duff in the understory of PRNS's forest stands gradually lose moisture.

Fire season at Point Reyes begins in early June. At this time, high-pressure air masses frequently stagnate over the Great Basin. Strong foehn winds, referred to as Mono winds in central California, may develop if there is a low-pressure trough off the coast. These winds bring warm, dry air to Point Reyes and cause rapid drying of fuels. These episodes usually last 1-2 days and fire danger can be extreme. In typical years, a persistent coastal fog bank is formed by July l, following the stabilization of the Pacific high over central California. From July through early September fog moves inland and back out to sea in a 3-4 day cycle in response to heating and cooling in California's Central Valley. Fine fuel moisture fluctuates in this cycle, while wood fuels and duff remain relatively wet. In mid-September the fog pattern changes and fuel moistures drop steadily. It is at this time that conditions contributing to Mono winds occur. The combination of prolonged drought, low relative humidity and a peak in fuel production often causes fire danger to be high through September and October. In addition, almost one fifth of the area's annual lightning storms occur during this period (Martin and Sugnet, 1984).

The late fall fire season is one of the primary constraints limiting the number of days available in the project area during which prescribed burns can be conducted each year. Other constraining factors are air quality and disruption of wildlife breeding periods.

In summary, the fire season at Point Reyes differs somewhat from most areas in the western United States. Bimodal peaks of fire danger occur in late spring and late summer/early fall. In most years, persistent fog keeps fire danger moderate in July and August when danger is highest in most of the western United States. The period from September 1 through October 31 can be considered the most critical time of fire danger for PRNS.

Fire History

Research into Historic Fire Cycles

There is evidence from dendrochronological (tree ring) records and from sediment core analyses that periodic fire has occurred in the project area for the past several thousand years, and ecosystems in the area have developed under the influence of these fires. Several native plant species in the project area (e.g., Bishop pine, Marin manzanita) reproduce abundantly following fire. For the past 100 years, however, fire frequency has decreased, and most fires have been suppressed. The lack of periodic fire during this period has resulted in changes in vegetation structure and species composition. For example, it is generally assumed that forest stand density in many areas has increased, and shrub and grassland habitats in many areas are being reduced in size due to encroachment by conifers. Populations of the Marin manzanita are becoming increasingly rare as a result of habitat loss due to shading from increasing forest stand density.

It has been well documented that fires in the Point Reyes area and within California coastal ranges were frequently set by Native Americans (Slaymaker, 1982; Keely, 2002) and European settlers. Fire history studies conducted in and around the peninsula show the northern coastal prairie was very important to the Coastal Miwok as a source of food. Seeds were harvested from the coastal prairie and other grasslands in late summer. Individual seed fields were the possession of specific families and were probably often burned after harvest to enhance growth the next year. Documentation of Coast Miwok culture indicates burning of grasslands for several purposes, but information on the extent and timing is minimal. Some sources indicate that fields were burned frequently, as often as once a year (Lewis, 1973; Slaymaker, 1982). Pre-contact burning along the coast may have focused on grasslands, while later burning during the Spanish and Anglo periods focused on shrublands to increase pasture acreage. The latter probably did not burn grasslands because of the need for winter livestock forage, leading to a very different fire regime (Greenlee and Langenheim, 1990).

Conditions conducive to lightning-caused wildfire do occur in Point Reyes, but they are rare (Martin and Sugnet, 1984). The Bay Area averages about 3 lightning days a year. An average of two lightning storms occur annually in the vicinity of Inverness with 18 percent of these storms occurring in September (Martin and Sugnet, 1984). Between 1970 and 1989, 13 lightning-ignited fires occurred in the following areas: Inverness Ridge, Mt. Tamalpais, and Stinson Beach. On September 27, 2001 a lightning fire occurred on Bolinas Ridge above Stinson Beach. During this same September storm, an observer saw about 60 lightning strikes from the Mount Barnabee

Lookout near Samuel P. Taylor State Park, adjacent to the National Seashore. In addition, Pacific Gas and Electric staff counted 4,600 lightning strikes in the Bay Area during this storm (Freed, 2001).

Regardless of the source of ignition, however, ecosystems of Point Reyes are not burning today with nearly the frequency they did in the past. This change in fire frequency can result in shifts from understory to overstory dominance, increases in fuel loads and changes in forest structure, including increases in ladder fuels, which may lead to increased incidence of overstory, stand-replacing fires (Covington et al., 1994).

The best records of Point Reyes fire history reside in fire-scarred tree rings in redwood, and to a lesser extent, in Douglas-fir trees. Bishop pines are relatively short-lived trees (100 to 120 years), and generally occur in single-aged stands which arise after a stand-replacing fires. While the age of a Bishop pine stand can give solid evidence of a single large fire, it yields little insight into longer-term fire history. Shrubs respond to burning by either sprouting back from their stumps, or by regenerating via seeds in the soil so little record of the physical evidence of fire is retained. The same is true of grassland species.

Due both to past logging and the relatively thin bark and low resistance to burning in Douglas-fir, Douglas-fir forests are a limited source of data on fire history. However, at least one research team (Brown et al.,1999) was able to extract data from fire scars on Douglas-fir and redwood trees at three locations in Point Reyes. The researchers found that fire scars did not extend much beyond the late 1700s. The oldest Douglas-fir tree found in the park dated to 1680, but this individual had no fire scars. Within the approximately two hundred-year period of fire scars (roughly 1800 to the present), researchers calculated a mean fire interval ranging from 7.0 to 13.0 years for the Douglas-fir forests. They were unable to cross-date any pre-settlement redwood trees, although some post-settlement trees did contain fire scars that successfully cross-dated with the Douglas-firs. Researchers speculated these trees were likely basal sprouts that established after the original redwood stand was logged, or grew in response to fire. Using fire scar information for burns from the early 1800s to the early 1900s, the researchers calculated a mean fire return interval in the redwood groves of 7.7 to 8.5 years.

Adjacent to Point Reyes, Finney (1990) found mean fire intervals between 1850 and 1900 that ranged from 6 to 33 years, with a mean of 14 years in coast redwood stands on Bolinas Ridge. He was able to document high fire frequency in the grove studied dating from the middle 1400s. Jacobs et al. (1985) calculated mean fire intervals of 22 to 27 years from stumps containing fire scars on ridges surrounding Muir Woods National Monument.

Work at Humboldt Redwoods State Park revealed a larger range in fire intervals, although this area has higher precipitation levels than Point Reyes and so is not directly comparable. Stuart (1987) calculated mean pre-settlement fire intervals in Humboldt from fire scars and redwood sprouts varied between 11 and 44 years. In the same area, Fritz (1932) estimated that at least 45 severe fires had burned during the previous 1,100 years, with a mean fire interval of 25 years. At Salt Point State Park, Finney and Martin (1989) found fire return intervals of 20.6 to 29.0 years. The authors state that all of these studies probably overestimate the actual mean fire interval.

Sediment taken from the bottoms of the lakes at the south end of Point Reyes Peninsula provides further evidence of forest fires over the past several centuries (Russell, 1983). In an on-going charcoal stratigraphy study by Anderson (2001), sediment cores from Glenmire and Wildcat lakes are being analyzed with radiocarbon dating. The Glenmire sample within the Douglas-fir forest; the Wildcat Lake area is dominated by coastal scrub. Sediments from both lakes indicated a near absence of fire during the past 100 years. Ongoing research is examining additional sediment cores from wetland areas in Point Reyes through radiocarbon dating and pollen analysis with the goal of constructing a more complete fire history.

Recent Fire History
The Marin County Fire Department has historically maintained a list of the larger fires in the county in the 20th century. Several of these fires have occurred in the project area. A fire in October 1917 burned 2,000 acres on the ridge west of Inverness. The largest fire, in September 1923, burned 40,000 acres from Lucas Valley to Bolinas including 35 homes in Woodacre.

More recently, the Mount Vision Fire burned more than 12,000 acres in 1995. It was started by an unattended campfire on October 3 at approximately 1:00 pm within Tomales Bay State Park. Driven by 40- to 50-mile per hour winds in steep terrain and heavy forest fuels, the fire rapidly burned 700 acres and spread to PRNS and the residential community of Paradise Ranch Estates where 48 structures were destroyed. By October 6, up to 1,200 firefighters had participated in suppressing the fire. The next night, October 7, 1995, the fire was declared contained after burning a total of 12,354 acres (11,598 acres NPS lands, 386 acres State Park lands, 370 acres of private lands). The fire was declared controlled 9 days later.

Since 1997 an average of three wildland fires have occurred each year in the project area. In all cases, the burned area was less than ten acres and most were kept to less than one acre. Most of the fires occurred in the Olema Valley, and all but one was human-caused.

AFFECTED ENVIRONMENT

Soils

The Marin County Soils Survey provides generalized baseline information on soils within the project area (SCS, 1985). Soils are classified into broad associations comprised of one or two major soil types, from which the name of the association is taken, and several minor soil types. As the FMUs share geologic substrate, they also share many of the same soil types. Generally, FMUs involve 3 general landscape types – alluvial fans and tidal flats, coastal dunes and uplands. However, the presence of the San Andreas fault zone and the opposing bedrock formations present on each side of the fault leads to a more complex mix of soil types.

When considering potential impacts to soils from fire and fire management actions, the important indices include soil permeability, topsoil infiltration, degree of slope, soil texture, compositional stability, plant cover and rainfall intensity. These factors can contribute to an understanding of the erosion potential of disturbed soils and are used in the Natural Resources Conservation Service Erosion Hazard Rating (EHR). The EHR, the general text rating given in the 1979 Soils Survey and first hand observations of NPS staff are combined to describe potential erosion hazard of Point Reyes soil types. Another important factor to consider is the potential for a soil type to develop hydrophobic (water-repellent) properties due to intense fires. Figure 14 shows soil types in the project area; they are described in more detail below.

Tomales Point FMU. The principal soil type in the Tomales Point FMU, Kehoe Variant coarse sandy loam, is derived from the quartz diorite of the underlying granite bedrock. Soil formed from granitic bedrock or coarse-grained bedrock, such as the Kehoe Variant and Sheridan Variant (see discussion below - Inverness Ridge FMU) soils appear prone to developing surface or subsurface hydrophobic properties during intense fires. If the vegetation cover of Kehoe soils is disturbed, the potential for erosion is slight in areas of gentle slopes and high in the drainages and steeper slopes above Tomales Bay. Erosion is currently controlled by overlying vegetation, primarily grasses and coastal scrub.

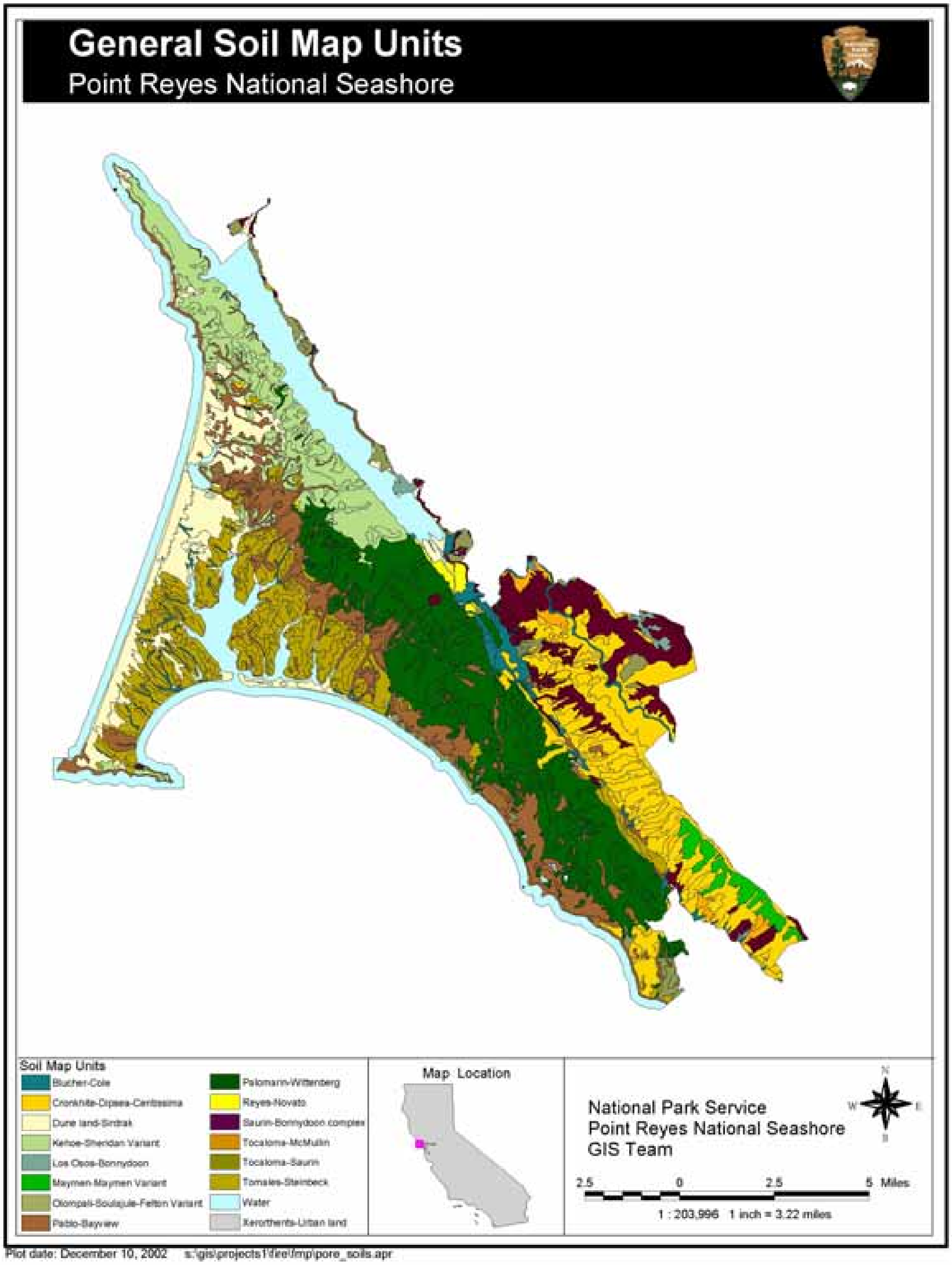
Headlands FMU has a complex soils map. Rock outcrops along the western and southern coast comprise nearly 1/3 of the land surface of the FMU. Found primarily west of Sir Francis Drake Highway, Sirdrak sand soils formed by wind-born (eolian) sands make up roughly 25% of the FMU. Kehoe Variant soils (described above for Tomales Point FMU) and Tocaloma McMullin complex soils make up much of the FMU east of Sir Francis Drake Highway. These two soil types have a high erosion potential when surface soils are disturbed. As previously noted, Kehoe Variant soils have potential to form a surface or subsurface hydrophobic layer under an intense fire.

Estero FMU. Approximately 72% of the Estero FMU soils are Tomales fine sandy loam, derived from underlying sandstone. Tomales loam tends to seasonal saturation due to very slow permeability. Slow permeability leads to more rapid runoff and a high potential for erosion on slopes than 15%. Principal drainages flowing to the Drakes Estero are Rodeo clay loam, a deep, alluvial soil formed in narrow valleys.

Inverness Ridge FMU. The northern half of the Inverness Ridge FMU is comprised primarily of Sheridan Variant soils, a coarse sandy loam derived from underlying quartz diorite bedrock. The soil type supports the bishop pine forests, grasslands and scrub. The erosion potential of these soils is high where slopes are greater than 50%. Sheridan Variant, supporting tanoak, Bishop pine and coastal scrub, often have a dense duff layer on the soil surface and a high percent of organic matter within the soil. Loss of the duff layer during a fire can exacerbate erosion potential of this soil.

During the 1995 Vision Fire, Sheridan Variant soils were subject to intense heating and most organic material was burned away. Post-fire monitoring noted a crust-like hydrophobic layer had formed in patchy areas on the surface soil. This layer was water repellent for the first winter season (1995-1996) but was largely broken up by the second winter season, primarily by the force of vegetation pushing through the surface layer. Since this area was subject to the most intense burn during the Vision Fire, it was surprising how much of the seedbed survived in the surface soils. The area is now densely vegetated with dense stands of bishop pine, grassland and coastal scrub.

Figure 14. Point Reyes National Seashore Soil Map Unites



Compared to other Point Reyes soils, Sheridan Variant soils have high percent of organic matter in the upper surface soils and could be prone to nutrient volatilization (vaporization) or changes in soil chemistry that reduce nutrient capacity during an intense fire.

The dominant soil type in the southern half of the FMU is the Inverness loam soils, another granite derived soil, which predominates throughout the central portion of the Inverness Ridge. Inverness loam soils were the major soil series in the area burned in the 1995 Vision Fire. Like the Sheridan Variant soils, they are of particular concern for potential high rates of surface runoff and very high potential for erosion where the vegetation cover is removed or burned away (BAER Team, 1996).

Limantour FMU. The northern section and eastern sections of this FMU, extending from Inverness Ridge east to Bear Valley Road, share the Sheridan Variant Inverness loam soils that support the Bishop pine forest. The southern portion of the FMU has Palomarin-Wittenberg complex soils, supporting Douglas-fir forest, that predominate on the southern half of the Inverness Ridge. Both soil types have a very high potential for erosion on steeper slopes and have an organic content in the upper soil horizon making the soil susceptible to nutrient loss if exposed to intense heat from fire. Tomales fine sandy loam predominates on the uplands between the principal drainages and soils within the Muddy Hollow and Laguna Creek drainages are alluvial Rodeo Clay loam.

The Vision Fire burned all of this FMU in the 1995. Post-fire monitoring noted pervasive hydrophobicity in soils in the upper drainage of Muddy Hollow extending from 2 to 8 inches in depth (Collins and Ketcham 2001). Hydrophobic properties broke down and nearly disappeared by the end of a second winter's rains. Post-fire monitoring recorded accelerated upstream channel cutting and hillside rilling in the upper drainages of the Muddy Hollow Creek system during the first year after the fire. In the first two years following the fire, soils in the middle drainage of the Creek eroded primarily from exposed areas such as old roadbeds and channel banks. Eroded sediments were deposited in a wide channeled alluvial fan at the base of the drainage especially during the second rainy season after the fire. Soil erosion was largely controlled by the third year post-fire as eroded areas in the watershed revegetated (B. Ketcham, pers. com.).

<u>Wilderness North FMU</u> is primarily Palomarin-Wittenberg complex soils supporting Douglas-fir forests on southern portion of the Inverness Ridge. The soils are derived from the underlying sandstone and shale and are deep and well drained with a 2 to 4 inch covering of Douglas-fir needles. The erosion hazard is very high on slopes greater than 50%. As noted previously, the high percent of organic content in the upper soil layer points to a potential for changes in soil chemistry in the event of a high intensity fire. The northern portion of the FMU burned in 1995.

<u>Wilderness South FMU</u> is also dominated by the Palomarin-Wittenberg complex soils though slopes are generally less steep than in the Wilderness North FMU. Like the Limantour FMU to the north, the west-facing slopes are thin, erodible Pablo Bayview soils. Less than 10% of the FMU on the steepest eastern slopes of Inverness Ridge is Dipsea Barnabe gravelly loam soil supporting Douglas-fir and redwoods. These soils are considered highly erosion-prone due to

the high gravel content (SCS, 1979). The Dipsea soils have the highest average percent of organic matter in the upper soil layer of all the Point Reyes soil types.

Highway One FMU. The Highway One FMU runs northwest to southeast along Highway 1 overlying the San Andreas fault zone and the floodplain of Olema Creek. It extends west to the lower slopes of Inverness Ridge and east to the top of Bolinas Ridge. Bedrock type differs distinctly on each side of the San Andreas fault leading to distinct soil types on each ridge. The slopes of Inverness Ridge are primarily highly erodible Tomales or Tomales-Steinbeck fine sandy loams derived from the underlying sandstone. The Olema Creek floodplain is comprised of alluvial soils, mainly clay loams and silt loams (Blucher-Cole complex and Rodeo clay loam) that have high water capacity tending to become saturated with very low rates of erosion. Soils on the west-facing slope of Bolinas Ridge are primarily highly erosive Centissima Barnabe soils supporting Douglas-fir and Redwood forest and grasslands and Cronkhite-Barnabe soils supporting primarily grasslands.

Bolinas Ridge FMU. The northern half of the Bolinas Ridge FMU shares the characteristics of the eastern portion of the Highway One FMU. Centissima Barnabe and Dipsea-Barnabe soils, both highly erosive, are on the ridgetops and steep side slopes of the Ridge and support Douglas-fir and Redwood forests. More gently sloped areas of Cronkhite-Barnabe soils exist on the ridgetop. The southern half of the FMU has shallow Maymen-Maymen Variant gravelly loam soils on the long uplands side slopes which have a high hazard of erosion and siltation.

Palomarin FMU. Similar to the Wilderness South FMU to the north, the spine of the Inverness Ridge in this FMU has Palomarin-Wittenberg soils and the rounded, west-facing slopes is composed of Pablo Bayview soils. Much of the southern half of the FMU consists of moderately sloped uplands. Side slopes in this region are covered with thick but erodible Cronkhite Barnabe soils supporting grasslands, and steeply sloped areas of Palomarin Wittenberg soils supporting Douglas-fir forest.

Table 7A. Erosion Hazard Potential Per FMU

FMU	Total Acres in FMU	Low erosion potential		Moderate erosion potential		High erosion potential		Very high erosion potential	
		Acres per FMU	% of each FMU	Acres per FMU	% of each FMU	Acres per FMU	% of each FMU	Acres per FMU	% of each FMU
Tomales Point	2,783	717	26%	245	9%	1,821	65%	--	--
Headlands	881	290	33%	347	39%	215	24%	--	--
Estero	1,639	200	12%	528	32%	911	56%	--	--
Inverness	1,250	225	18%	388	31%	466	37%	171	14%
Limantour	4,144	828	20%	543	13%	1924	46%	824	20%
Wilderness North	1,591	27	2%	224	14%	313	20%	1027	64%
Wilderness South	2,298	179	8%	654	28%	777	34%	683	30%
Highway 1	2,868	285	10%	246	9%	1798	63%	539	19%
Bolinas	2,382	9	>1%	764	32%	1,054	44%	555	23%
Palomarin	2,022	161	8%	420	21%	1082	53%	324	16%
ALL FMUs	21,858	2,921	13%	4,359	20%	10,361	47%	4,123	19%

Air Quality

PRNS is classified as a mandatory Class I area under the Federal Clean Air Act and Amendments. Title I of the Clean Air Act Amendments of 1990, Part C, “Prevention of Significant Deterioration of Air Quality,” Section 162, defines Class I areas as including all national parks greater than 6,000 acres. The areas must have been in existence on the date of enactment of the Clean Air Act Amendments in 1977.

The NPS, as the Federal Land Manager (FLM) of PRNS, is responsible for the protection of the park from ambient air quality impacts, including air quality-related values (AQRVs) such as visibility and the protection of plants, animals, soils, water quality, cultural and historic structures from the effects of contaminants. The northern lands of the GGNRA, comprising Bolinas Ridge directly east of Highway One is administered by PRNS and included in the scope of this FMP, are a federal Class II area.

PRNS is located in the San Francisco Air Basin and is under the jurisdiction of the Bay Area Air Quality Management District (BAAQMD). The BAAQMD is the agency that is directly responsible for the protection of air quality and implementation of local and State Implementation Plan (SIP) measures within the Bay Area region. The BAAQMD regulates air quality under the auspices of the California Air Resources Board (CARB) and the U.S. Environmental Protection Agency (EPA), Region 9. Both CARB and the EPA have general oversight responsibilities for the purpose of making sure local rules and regulations and stationary source permits issued are consistent towards attainment and maintenance of the California and National Ambient Air Quality Standards (AAQS). The AAQS are discussed later in this section. Mobile sources are not regulated at the local level except in certain instances where they are strongly associated with a stationary source project, such as a power plant. Otherwise, under the mandated authority of the EPA, mobile source emissions are regulated by CARB.

In the 2000 Census, Marin County had a total population of 247,289 (U.S. Census Bureau, 2000). Most of the population of Marin County lives to the south and east of the project area; other populated areas (including Petaluma, in Sonoma County) are located in a more easterly direction inland from Point Reyes. In the vicinity of PRNS, a scattered population lives in the small towns of Inverness, Inverness Park, Olema, and Bolinas, Point Reyes Station and along Highway 1. Private development on and/or west of Highway 1, especially near Bolinas and western Inverness, occurs in or near high fuel densities in and beyond the project area representing public/private land interfaces across which the propagation of fire and/or smoke can be a serious threat.

Protecting public and firefighter health and safety, and protecting private and public property are primary goals of the FMP. In each of the alternatives, strategies to offer this protection include the use of prescribed burns and mechanical treatment, including firebreaks to limit the potential expansion of a future wildland fire. In addition to offering protection of property, this strategy would result in several smaller episodes of smoke, rather than a severe fire with severe smoke and pollutant emissions.

In 1993, the EPA adopted conformity regulations implementing Section 176 of the Clean Air Act, as amended. Section 176 requires that federal actions conform to state implementation plans for achieving and maintaining the national standards. Federal actions must not:

- Cause or contribute to new violations of any standard,
- Increase the frequency or severity of any existing violation,
- Interfere with timely attainment or maintenance of any standard,
- Delay emission reduction milestones, or
- Contradict State Implementation Plan requirements.

The conformity rule applies only in federal non-attainment areas. PRNS has historically ensured conformity by ensuring that all prescribed burning is planned and performed within the auspices of the BAAQMD Smoke Management Program.

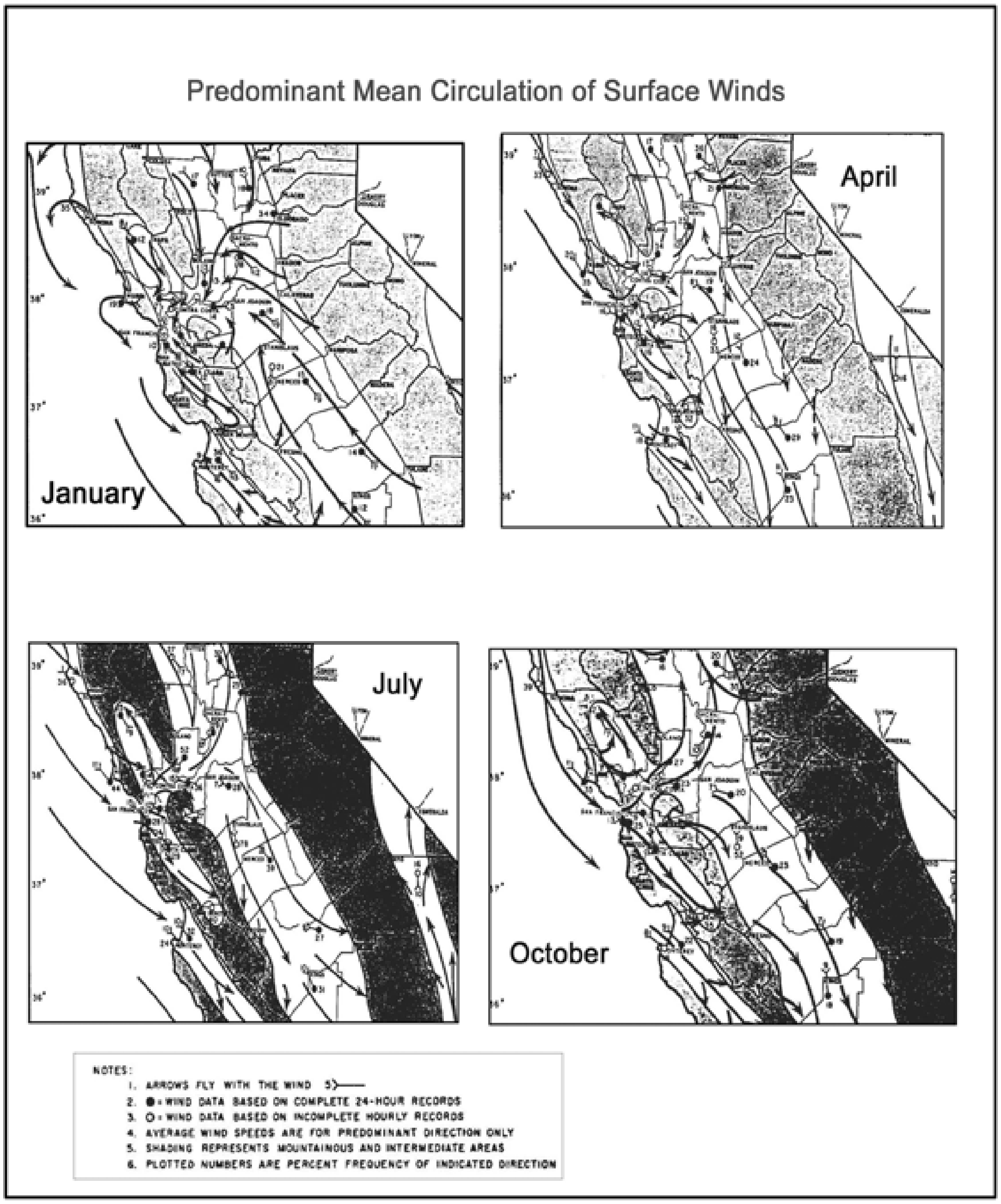
Regional Climate

PRNS receives an average of 38.2 inches of rain annually. This amount is higher than much of the San Francisco Bay area due to the somewhat more elevated terrain along the coast. Most annual rainfall in Marin County occurs from November through March. The following general climate description is from "Climate, Physiography, and Air Pollution Potential – Bay Area and its Subregions (BAAQMD, 2003a)":

> "Areas along the West Coast of Marin County are usually subject to cool marine air. In the summer months, the marine air is cooled as it passes over the offshore upwelling region, and forms a fog layer along the coast. In the winter, proximity to the ocean keeps the coastal regions relatively warm. Temperatures do not vary much over the year at these coastal areas: high 50s in the winter and low 60s in the summer. The warmest months are September and October, which are in the mid to high 60s."
>
> ". . .Wind speeds are highest along the west coast of Marin, about 8 to 10 mph. Although most of the terrain throughout central Marin County is not high enough to act as a barrier to the marine airflow, the complex terrain creates sufficient friction to slow the airflow. Downwind, at Hamilton Air Force Base in eastern Marin County, the annual average wind speeds are only 5 mph. The prevailing wind directions throughout Marin County show less variation, and are generally from the NW."

Figure 15 illustrates predominant wind patterns occurring in California (Bell, 1958). The predominant regional surface winds during winter flow from the north-northeast. During spring and summer, stronger north-northwest winds dominate. These northwesterly winds are primarily caused and/or strengthened by the combination of high pressure offshore and the warmer air inland. During the fall transition, when warm easterly winds break through to the coast while inland conditions remain hot and dry, the coastal region faces its most significant fire threat.

Figure 15. Predominant Wind Patterns Occurring in California



Project Area

Long-term average temperature and precipitation data have been collected at Bear Valley at the eastern part of the Point Reyes National Seashore (NPS, 2003). The Bear Valley monitoring station is the closest surface meteorological station to the project site. Surface climate data are presented in Table 8. Average temperatures (°F) during the summer vary from the high 40s to the low-to-middle 70s. Summer precipitation is low, averaging less than 0.2 inches per month, due to the strong stationary high-pressure system located off the coast and preventing weather systems from moving through the area. During the winter, average temperatures (°F) vary from the mid-to-upper 30s to the upper 50s-low 60s. About 84% of the precipitation in the area occur during November through March, generally in association with storm systems that move through the region.

Table 8. Temperature and Precipitation Data for Bear Valley- Point Reyes National Seashore, California

	Average Daily Temperature (°F)[a]			Average Precipitation
Month	Minimum	Maximum	Daily	(inches)
January	36.5	58.6	47.7	8.65
February	39.5	62.1	50.8	6.69
March	39.7	63.0	51.4	5.64
April	39.5	65.4	52.4	2.42
May	44.0	68.0	56.7	1.07
June	46.6	71.1	58.9	0.20
July	48.6	73.9	61.2	0.09
August	49.4	74.4	61.9	0.14
September	48.0	75.7	61.9	0.34
October	44.1	72.3	58.2	2.10
November	39.7	64.9	53.1	5.68
December	35.9	59.0	47.5	6.27
Annual Average	42.0	66.2	54.2	39.57 (total)

Source: Pt. Reyes National Seashore, 2003.
[a]Average temperature and precipitation data for 1964-1989.

Atmospheric stability and mixing heights are important parameters in determining pollutant dispersion. Atmospheric stability is a parameter that reflects the amount of atmospheric turbulence and mixing. In general, the less stable an atmosphere, the greater the turbulence, resulting in more mixing and better dispersion. Good ventilation results from deep vertical mixing and at least moderate wind speeds within the mixing layer.

The frequent occurrence of temperature inversions over the project area and its surroundings limits the air mixing height and, consequently, could concentrate air pollution levels near the ground. Mixing heights generally increase as the air temperatures increase, so that more dilution occurs during hot weather or the heat of the day. Enhanced vertical mixing typically accompanies the warm easterly fall winds that lead to the most significant fire threats in the project area. Pollutants are comparatively more concentrated near the ground during colder weather or after sunset. The marine dominated cool spring and summer conditions feature limited vertical mixing, but the cool moist conditions are not conducive to fire generation or propagation. The air pollution potential in the region is moderated by the strong westerly winds most of the year.

The climate of the project area, along with much of the West Coast of the country, is controlled by a semi-permanent high-pressure system centered over the northeastern Pacific Ocean. The copious late fall through spring precipitation provides significant moisture. In the summer, the relatively northern location of this strong high-pressure system results in clear skies further inland and coastal fog. Very little precipitation occurs during the summer months because storm systems are blocked by the high-pressure system. Fog, humidity, and cool temperatures, though, help vegetation in the project area dry more slowly. Beginning in the fall, high pressure forming over the warmer inland areas breaks the summer pattern, introducing warm, dry winds from the northeast and east. These conditions lower vegetation moisture levels and significantly increase fire threat. Through the winter, the high-pressure system weakens and moves south, allowing storm systems to move through the area, replenishing the vegetation moisture levels and restarting the annual cycle.

Regional Air Quality
The project area lies within the Bay Area Airshed managed by the BAAQMD. Within California, compliance with federal and state AAQSs is determined by airshed. The BAAQMD encompasses urban, rural, coastal and inland settings. As would be expected, areas with high population density also tend to have higher ambient air quality impacts from stationary and mobile sources.

California AAQS standards are values that are generally not to be exceeded. Federal standards are not to be exceeded more than once per year. The attainment status of the BAAQMD with regard to the federal and state AAQSs is shown in Table 9.

Table 9. Ambient Air Quality Standards & Bay Area Attainment Status

		California Standards		National Standards	
Pollutant	Averaging Time	Conc.	Attainment Status	Conc.	Attainment Status
Ozone	8 Hour			0.08 ppm	U
	1 Hour	0.09 ppm (180 µg/m3)	N	0.08 ppm (235µg/m3)	N
Carbon Monoxide	8 Hour	9.0 ppm (10 mg/m3)	A	9 ppm (10 mg/m3)	A
	1 Hour	20 ppm (23 mg/m3)	A	35 ppm (40 mg/m3)	A
Nitrogen Dioxide	Annual Average			0.053 ppm (100 µg/m3)	A
	1 Hour	0.25 ppm (470 µg/m3)	A		
Sulfur Dioxide	Annual Average			80 µg/m3 (0.03 ppm)	A
	24 Hour	0.04 ppm (105 µg/m3)	A	365 µg/m3 (0.14 ppm)	A
	1 Hour	0.25 ppm (655 µg/m3)	A		

Pollutant	Averaging Time	California Standards		National Standards	
		Conc.	Attainment Status	Conc.	Attainment Status
Particulate Matter (PM10)	Annual Arithmetic Mean			50 µg/m3	A
	Annual Geometric Mean	30 µg/m3	N		
	24 Hour	50 µg/m3	N	150 µg/m3	U
Particulate Matter - Fine (PM2.5)	Annual Arithmetic Mean			15 µg/m3	U
	24 Hour			65 µg/m3	U
Sulfates	24 Hour	25 µg/m3	A		
Lead	Calendar Quarter			1.5 µg/m3	A
	30 Day Average	1.5 µg/m3	A		
Hydrogen Sulfide	1 Hour	0.03 ppm (42 µg/m3)	U		
Vinyl Chloride (chloroethene)	24 Hour	0.010 ppm (26 µg/m3)	No information available		
Visibility Reducing particles	8 Hour (1000 to 1800 PST)	(See note 7)	U		

NOTES
A=Attainment N=Nonattainment U=Unclassified
ppm=parts per million mg/m3=milligrams per cubic meter µg/m3=micrograms per cubic meter

Western Marin County Air Quality

BAAQMD, describing air pollution trends in Marin County in 2000, does not address western Marin but focuses on the principal traffic corridors.

"Air pollution potential is highest on the eastern side of Marin County. This is where the semi-sheltered valleys and largest population centers are located. Currently, most of the development has been along the bay, particularly in southern Marin. In the south, where distances to the ocean are short, the influence of the marine air keeps the pollution levels low. As development moves further north where the valleys are more sheltered from the sea breeze, it would encounter greater pollution potential (BAAQMD, 2003a)."

The only air pollution currently measured at Point Reyes is $PM_{2.5}$, small particulate aerosols that affect acid deposition and regional haze. Since no other ambient air pollutant is measured locally, air quality data were obtained from other BAAQMD monitoring stations within the Marin County Air Basin. The closest ambient air monitoring station to the project area is in San Rafael. However, as San Rafael is heavily urbanized, the data from that site would not be representative of the project area. Instead, data from the city of Santa Rosa (approximately 25 miles to the northwest) is used to represent background concentrations of particulate matter of 10 microns or less diameter (PM_{10}), carbon monoxide (CO), ozone (O_3), and nitrogen oxides (NO_x) for the project area. Data from the Vallejo station (approximately 30 miles to the east) is used for background sulfur dioxide (SO_2) (BAAQMD, 2003b). It is anticipated that actual ambient pollutant concentrations at the PRNS are lower than the background concentrations at Santa Rosa and Vallejo because the project area and surroundings feature less human and commercial activity and more steady onshore winds. However, the Santa Rosa and Vallejo monitoring station concentrations are used as conservative estimates.

In summary, the maximum 3-year average from the three most recent years (during 1999-2001) of 74 µg/m^3 in Santa Rosa complies with the federal standard for ambient particulates smaller than 10 microns of 150 µg/m^3, but does not meet the stricter California standard of 50 µg/m^3. It is well below both the maximum one-hour and eight-hour average federal and state standards for carbon monoxide, and the state and federal one-hour (state) and annual average (federal) standards for nitrogen dioxide. Vallejo is also well below the federal and California maximum 24-hour and annual average standards for sulfur dioxide. Results for ozone are presented in Table 10 below.

Table 10. Ambient Ozone Standards and Levels at Santa Rosa: 1999-2001

	Federal Ambient Air Quality Standard	California Ambient Air Quality Standard	Maximum 3-Year Average 1999-2001	Compliant with Ambient Air Quality Stds
Maximum 1-Hour Average	0.12 ppm (235 µg/m^3)	0.09 ppm (180 µg/m^3)	0.10 ppm	- - -
Number of Days Exceeding California Standard (0.09 ppm; 1-hour avg.)	- - -	- - -	1	Federal: Yes California: No
Number of Days Exceeding Federal Standard (0.12 ppm; 1-hour avg.)	- - -	- - -	0	- - -
Maximum 8-Hour Average	0.08 ppm (157 µg/m^3)	- - -	0.08 ppm	Yes
Number of Days Exceeding Federal Standard Concentration	- - -	- - -	0	- - -

Note: The maximum ambient air quality average concentrations occurred in 1999.

Santa Rosa has exceeded the state's maximum 24-hour average of 50 µg/m^3 twice over the three year period measured, and the California one-hour ozone standard once. The PM_{10} data in Table 10 reflects two exceedances of the California 24-hour AAQS. The area is in compliance with all other ambient air quality standards.

The annual ambient air quality standard for particulate matter in California is about to become more stringent, upon approval by the Office of Administrative Law. (Refer to Table 9, footnotes.) The affect this may have on future compliance status of the region remains to be seen. Further, the federal and California standards for particulate matter of 2.5 µg/m^3 or less would be enforced pending sufficient baseline monitoring data collection, as determined by the U.S. Environmental Protection Agency. Currently, the $PM_{2.5}$ standard is not enforced. Project activities are expected to be minimally affected since all prescribed burning would continue to occur under the auspices of the BAAQMD Smoke Management Program, which would be planned and managed to ensure conformity with all applicable rules and regulations.

Project Area Air Quality

The federal and state $PM_{2.5}$ ambient air quality standards shown in Table 9 are proposed, but not yet in place. When fully implemented, the federal 24-hour standard will be attained when 98 percent of the daily concentrations, averaged over 3 years, are equal to or less than the standard.

The NPS has been collecting $PM_{2.5}$ data at the PRNS for several years. The most recent available years of data (1999 through 2001) indicate a daily average concentration of 8.330 µg/m^3 or less averaged over these three years of data, well below the state and federal AAQSs of 12 and 15 µg/m^3 respectively. PRNS data available to date indicates 24-hour averages well below the proposed federal $PM_{2.5}$ AAQS of 65 µg/m^3.

Water Resources

The water resources within the project area include a significant number of perennial and intermittent streams, human-made impoundments, wetlands, natural lakes and sag ponds. The water resources support a variety of threatened and endangered species including coho salmon, steelhead trout, California freshwater shrimp, and California red-legged frog. Beginning in 2000, the NPS began surface water quality monitoring at 23 stream locations and three recreational ponds within 12 watersheds. Implemented in conjunction with fisheries monitoring efforts, the water quality program is focused on identifying water quality impacts to the aquatic ecosystems on NPS managed lands. Results indicated distinct differences in monitored water quality parameters between watersheds that supported dairying, ranching or wilderness. Of the water quality parameters measured, two in particular – Total Suspended Solids (TSS) and nitrogen - could be exacerbated by fire management activities, so data that has been gathered on the water quality of creeks in the project area will be important when considering potential affect.

Ash generated by fires is rich in nitrogen, a nutrient essential to biotic reproduction. Excess nitrogen in a water body can increase production of algae and aquatic plants. Decay of this excessive biomass can deplete a water body of oxygen and lead to fish kills. Ash is rich in nitrogen and could contribute to higher nutrients levels in stormwater runoff following burning. Following one year of water quality sampling, it was clear that at most of the 23 sites, current nitrogen levels, measured as nitrate and nitrite, were below detectable limits (>0.2 mg/l) (Ketcham, 2001). The exception was in one watershed supporting dairying operations.

The activities in the FMP could also result in increases in erosion. Localized compaction, removal of vegetation and burning all cause changes in the proportion of water infiltrating into soil to that which is surface runoff. Increases in rates and velocity of runoff can increase erosion, which in turn can lead to elevated levels of TSS flowing to wetlands, ponds, and creeks in the project area. TSS is made up of sediments and other materials suspended in the water column. High TSS is common during storms and flooding. Extremely high level of sediments can also injure fish by clogging their gills, obscuring the presence of food, or covering the gravel surface of spawning areas. All watersheds sampled for the Point Reyes National Seashore Water Quality Monitoring Report (Ketcham, 2001) had TSS that exceeds the recommended standard. Sampled watersheds were Lagunitas Creek, Olema Creek, Drakes Estero, Drakes Bay, and Pacific Drainages. Sediment data was not collected from the Bolinas Drainages, Pine Gulch Creek or Tomales Bay watersheds.

In addition to water quality, fire management activities can affect characteristics of a watershed. Individual watersheds are defined as the total area of land surface from which a body of water, an aquifer or a river system collects its water. There are many scales of size by which watersheds can be defined; the watershed for a major river may encompass a number of smaller watersheds that ultimately combine at a common point.

For purposes of planning for the management of NPS water resources, NPS staff scientists consider watersheds in relation to the extent of NPS resource management responsibility and the presence of sensitive biological resources. Overall, the NPS has management responsibility for portions of the Tomales Bay Watershed, the Lagunitas Creek watershed, the Pine Gulch Creek watershed, Bolinas Drainages, Olema Creek watershed, all of the Pacific Drainages (Kehoe, Abbotts Lagoon, etc.), Drakes Bay, and Drakes Estero watersheds. Study area watersheds are shown in relation to the 10 FMUs in Figure 16 and 6. Table 11 lists FMUs that either fully or partially within each watershed. This information is important in understanding how projects planned for distinct FMUs could potentially impact the same watershed.

Table 11. Percent of Project Area in Project Watersheds

Watershed	**FMU**	**% of the Watershed in an FMU**	**Percent of FMU in Watershed**
Tomales Bay	Inverness Ridge	1%	26%
	Limantour Road	3%	18%
	Tomales Point	6%	67%
	Wilderness North	4%	75%
		14% of watershed w/in FMUs	
Lagunitas Creek	Bolinas Ridge	3%	56%
		3% of watershed w/in FMUs	
Olema Creek	Bolinas Ridge	6%	25.446
	Highway One	14%	25%
	Wilderness South	8%	34%
		28% of watershed w/in FMUs	
Drakes Bay Drainages	Headlands	4%	52%
	Limantour Road	6%	20%
	Palomarin	0%	2%
	Wilderness North	3%	21%
	Wilderness South	11%	63%
		24% of watershed w/in FMUs	
Drakes Estero	Estero	9%	100%
	Inverness Ridge	5%	74%
	Limantour Road	14%	61%
	Wilderness North	0%	0%
		29% of watershed w/in FMUs	
Pacific Drainages	Headlands	4%	48%
	Tomales Point	9%	33%
		13% of watershed w/in FMUs	
Bolinas Drainages	Bolinas Ridge	3%	11%
	Highway One	7%	18%

Watershed	FMU	% of the Watershed in an FMU	Percent of FMU in Watershed
	Palomarin	23%	90%
		33% of watershed w/in FMUs	
Pine Gulch Creek	Bolinas Ridge	3%	7%
	Highway One	20%	35%
		23% of watershed w/in FMUs	

Roughly 200 square miles of western Marin County drains to Tomales Bay, including Olema and Bear Valley creeks. For the FMP, this large drainage basin is split into its constituent subwatersheds to allow for a more detailed scrutiny of potential effects to sensitive resources located in distinct parts of the greater drainage area. Olema Creek and Lagunitas Creek are addressed as separate watersheds and the Tomales Bay Watershed itself is limited to the 45 square miles of land encircling the Bay (see Figure 16). The following descriptions characterize water quality in each FMP watershed in the study area.

Tomales Bay Watershed. The NPS manages approximately 28% or 13 square miles (8,266 acres) of the 45 square mile (29,219 acres) Tomales Bay Watershed shown on Figure 16. The remainder of the watershed lands is privately managed by either the Marin Municipal Water District or California State Parks, or privately held land. Tomales Bay and Drakes Estero are home to a number of oyster production operations accounting for nearly 35% of the oyster production in the state of California. The San Francisco Bay Regional Water Quality Control Board (RWQCB) has listed Tomales Bay and its major watersheds, Lagunitas Creek and Walker Creek, as impacted by sediment, nutrients, and pathogens under Section 303 (d) of the Clean Water Act. In addition, the RWQCB has also listed Tomales Bay and Walker Creek as impaired by mercury. The RWQCB is required by the EPA to develop and implement TMDLs for each pollutant parameter by 2010. FMP actions that could increase erosion have the potential to affect sediments and nutrients levels of Bay waters. Portions of the Inverness Ridge, Limantour, Tomales Point and Wilderness North FMUs are located in the Tomales Bay Watershed.

Lagunitas Creek Watershed. The northern portion of the Bolinas Ridge FMU is in the northwestern portion of the Lagunitas Creek watershed. The 83-square mile watershed that drains to the head of Tomales Bay provides much of Marin County's drinking water through the Marin Municipal Water District. Four dams with storage in excess of 60,000 acre-feet on Lagunitas and Nicasio creeks have significantly altered the hydrology and ecology of these creeks. The dams have also eliminated nearly two thirds of the spawning habitat of populations of the coho salmon and steelhead trout, listed as threatened species under the Endangered Species Act. Other federal threatened and endangered species in the watershed include the California red-legged frog and California freshwater shrimp.

Olema Creek Watershed. The 14.5 square mile (37.5 square kilometers) Olema Creek watershed supports viable populations of coho salmon and steelhead trout. The Creek also supports California red-legged frogs. Approximately 90% of the lands in the Olema Creek Watershed are managed by the NPS. Olema Creek has been the subject of extensive monitoring to determine the effectiveness of various stream protection measures – including riparian exclusion fencing and habitat restoration. Water quality sampling by the NPS found elevated levels of TSS in this watershed. The source of the elevated sediment levels may be soils disturbed by instability along the San Andreas fault zone, due to past logging, and a result of past and current agricultural land uses within the watershed.

<u>Drakes Bay Watersheds.</u> Drakes Estero and the Estero de Limantour comprise a complex estuarine system capturing flow from more than 13.5 square miles (35 square kilometers) and draining through the Estero inlet. Steelhead trout are found in several of the contributing creeks draining to this watershed including Laguna, Muddy Hollow, Glenbrook, Home Ranch, East and North Schooner Creek. Several smaller creeks are characterized as rather small, steep drainages that discharge directly to the beach. The Estero is susceptible to nutrient and other inputs from grazed lands within the watershed and increased sediments from areas burned during the Vision Fire. Water quality monitoring by the NPS found the indicators for these potential pollutants currently within acceptable levels.

<u>Pacific Ocean Watersheds.</u> The primary watersheds draining to the open ocean are from the north, and include McClures, Kehoe North, Kehoe South, E Ranch and Lighthouse. There are a significant number of smaller drainages north of Kehoe Beach that empty into the ocean such as Elk Fence, and others. There are a number of intermittent dune watersheds that are not included in this list but occasionally drain to the ocean across the ten-mile beach. North and South Kehoe Creeks converge approximately ¼ mile upstream of Kehoe Lagoon.

The Abbott's Lagoon watershed drains across gently sloping terrain and into a unique lagoon environment. A human-made pond and a dual chambered lagoon separated by a bedrock sill provide a unique combination of brackish and freshwater environments in a system that often has the same surface water elevation. The lagoon does not breach regularly remaining closed for years at a time.

Water quality monitoring, as part of a focused study by the USGS in partnership with the NPS, is underway in Abbott's Lagoon to address pollutants flowing and develop prevention or reduction strategies. Current approximately 6.1% (or 188 acres) of the lands within the Abbotts Lagoon watershed is responsible for contributing most of the increased nutrient levels to the lagoon. Plans are proposed to construct facilities at a dairy within these lands that would reduce the levels of nutrients, sediments and pathogens flowing to the lagoon.

<u>Bolinas Drainages.</u> The Bolinas drainages include Double Point, Arroyo Hondo, and RCA. Following the major drought (1976-77) the NPS allowed the Bolinas Community Public Utilities District to enact their appropriated water right from Arroyo Hondo, in order to protect stream flow and habitat in the Pine Gulch Creek Watershed. The upper watershed of Arroyo Hondo Creek are located within the Philip Burton Wilderness and are managed as a Public Water Supply Watershed.

<u>Pine Gulch Creek Watershed.</u> Pine Gulch Creek is the largest watershed draining to Bolinas Lagoon. The Creek supports coho salmon, steelhead trout, and the California red-legged frog. Approximately 85% of the lands in this watershed are managed by the NPS. Of all the project

watersheds, Pine Gulch Creek was historically the most heavily logged and erosion from the past logging activities has been contributing sediment to Bolinas Lagoon for roughly 100 years. The lagoon is now the subject of an intensive restoration plan process coordinated through Marin County and the US Army Corps of Engineers exploring dredging to restore tidal prism. Important watershed management issues in the study are the protection of the stream and lagoon from additional sedimentation and deposition.

Impoundments, Natural Lakes, and Sag Ponds
The project area contains more than 75 impoundments and many are known to support the California red-legged frog. Most of these facilities were constructed by former landowners for stock watering or development. The condition of these many of these ponds is not well known and the stability of many is likely compromised by the presence of brush and trees on the dam structure. Activities conducted near pond facilities would protect pond edges and dam structures when planning specific prescription burns or mechanical fuel reduction projects.

Within the Olema Valley, a number of naturally occurring sag ponds associated with the San Andreas Fault provide unique aquatic habitat. The southwestern part of the project area, from Palomarin to Double Point is dotted with ponds and lakes derived from massive slope failure events. These water bodies, such as Bass, Pelican, and Crystal Lake are naturally occurring.

Vegetation

PRNS owes much of its distinctive character to the assemblage of plants that occur on the Peninsula. Plant communities create patterns that reflect the underlying geologic formations and soils and the influence of a moist, maritime climate. PRNS is known to support over 910 plant species. Fifty-five of these are of management concern (see Table 12 and 13) in Special Status Species) and include the federally-listed endangered beach layia (*Layia carnosa*), Tidestrom's lupine (*Lupinus tidestromii*), Sonoma alopecurus (*Alopecurus aequalis var. sonomensis*), Sonoma spineflower (*Chorizanthe valida*) and robust spineflower (*Chorizanthe robusta*). Of the 910 plant species, roughly one third are not native to the area.

Vegetation in the project area has been subject to human activities for 7,000 - 10,000 years, a time evidence suggests is concomitant with the first occupation of the area by the Coast Miwok. Although data are not available on the effects of Miwok activities on vegetation, it is assumed that they gathered plants for food and for shelter materials, and probably used fire to manipulate the growth of plant species. Beginning in the mid-nineteenth century and continuing into the present, activities such as land clearing, timbering, cultivation, cropping, road building, commercial development and livestock grazing have markedly affected the vegetation.

For purposes of analysis, the 90,311-acre project area has been divided into 9 broad vegetation types. Acreage estimated for each type in the project area and brief descriptions are presented below. Acreage was estimated from the Point Reyes vegetation map and is rounded to the nearest 100 acres. Vegetation types correspond most closely to the community level in the vegetation map classification hierarchy.

Table 12. Acres Within Each General Vegetation Class Within Each Fire Management Unit

Vegetation Class / FMU	Bishop Pine Forest	Douglas-fir/ Coast Redwood Forest	Hardwood Forest	Monterey Pine/ Monterey Cypress	Riparian Woodland	Coastal Scrub	Grass-land	Pasture	Coastal Dune	TOTAL
Tomales Point	0	0	24.9	5.6	64.3	1518.9	1006.7	0	12.5	2632.9
Headlands	0	0	0	0	1.8	400.7	299.4	38.1	51.3	91.3
Estero	2.2	0	5.3	37.0	37.9	520.2	913.1	16.9	0	1532.6
Inverness Ridge	646.3	55.7	12.5	0	46.2	245.6	143.8	84.4	0	1234.5
Limantour Road	140.9	748.4	216.9	12.1	371.5	2,040.3	462.2	13.6	0.2	4006.1
Wilderness North	0	1,262.3	103.5	0	4.0	130.6	88.4	0	0	1588.8
Wilderness South	0	1,673.3	128.0	0	54.0	303.6	85.5	0	0	2244.4
Highway One	0	719.3	771.1	0	112.4	421.6	797.4	8.8	0	2830.6
Bolinas Ridge	0	755.4	570.0	0	5.9	203.4	846.7	0	0	2381.4
Palomarin	0	624.3	92.2	0.08	58.4	889.0	190.2	0.1	0	1854.3
TOTAL	789.4	5,838.7	1924.4	54.78	756.4	6,673.9	4,833.4	161.9	64	21096.9

<u>Bishop Pine Forest (3,700 acres).</u> Bishop pine (*Pinus muricata*) is the dominant tree species in the forest/woodland community found on the northern portions of Inverness Ridge. Madrone (*Arbutus menziesii*), tanoak (*Lithocarpus densiflorus*), coast live oak (*Quercus agrifolia*) and California bay (*Umbellularia californica*) are often present in significant cover. Huckleberry (*Vaccinium ovatum*) is important to dominant in the shrub layer. Other species common in the understory include salal (*Gaultheria shallon*) and swordfern (*Polystichum munitum*). Stands of Bishop pine tend to be even-aged, usually originating after a stand-destroying fire. In the project area, approximately 65% of the Bishop pine forest is mature; the remaining 35% of the total forest area burned in the Vision Fire. The areas burned in 1995 are characterized by a patchwork of extremely dense stands of 12 to 15 foot tall, regenerating pines alternating with extremely dense stands of blue blossom (*Ceanothus thrysiflorus*) and Marin manzanita (*Arctostaphylos virgata*).

This vegetation type also includes a small amount of non-native Monterey pine (*Pinus radiata*) and Monterey cypress (*Cupressus macrocarpa*) stands, amounting to less than 5% of the total forest/woodland acreage. These stands are characterized by planted groves dominated by either tree species, invasive in some areas, usually with sparse to low shrub and herbaceous cover. The understory species in these stands are often non-native.

Bishop pines are limited in distribution, and occur only in relict stands in California, from Humboldt to Santa Barbara counties, on Santa Cruz and Santa Rosa islands, and in isolated populations south to central Baja. Vegetation mapping in the park indicates approximately 3,570 acres of Bishop pine forest occurring within Seashore boundaries. In 1995, approximately 35% (1,250 acres) of this acreage was burned in the Vision Fire. Following the fire, most of the pines in the area were dead and the formerly deep litter layer had been burned away. The bare, charred soil was covered with extremely large numbers of Bishop pine seeds. Regeneration in the burned area has been prolific, with dense stands of young Bishop pine growing up to replace the burned forests. One year following the fire, large dense patches of Bishop pine had recolonized the burned area.

Fire plays an important ecological role in maintaining Bishop pine forests. Stands of Bishop pine are characteristically even-aged, originating after fires, and their cones persist for many years, usually opening as a result of fire. Bishop pine stands are often dense, and stand-replacing crown fire typically occurs in such stands. It is hypothesized that a fire-free period of 80+ years would allow trees to succumb to diseases and die without reproducing. Bishop pine is susceptible to rust gall infection and to secondary fungal infections.

Douglas-fir/Coast Redwood Forest. The Douglas-fir (*Pseudotsuga menziesii*) and Coast redwood (*Sequoia sempervirens*) forest is the most common forest type in the project area. The forests reach a maximum height of 165 to 230 feet (50-70 meters) in the project area. Approximately 90% of this type of forest in the park is dominated by Douglas-fir while the other 10% is primarily redwoods.

In the project area, the Douglas-fir-dominated forest is characterized by a strong component of hardwood trees, usually California bay (*Umbellularia california*), but tanoak (*Lithocarpus densiflorus*) or individual coast live oaks (*Quercus agrifolia*) may be present. The shrub understory is highly variable, but is usually moderate to very dense. Coffeeberry (*Rhamnus californica*), huckleberry (*Vaccinium ovatum*), California hazel (*Corylus cornuta*), poison oak (*Toxicodendron diversilobum*) and coyote brush (*Baccharis pilularis*). Swordfern (*Polystichum munitum*) often dominates the herbaceous layer.

In those areas where redwood is the dominant tree in the forest canopy, tanoak is often a significant component, sometimes co-dominating with redwood. California bay or Pacific madrone (*Arbutus menziesii*) are also often present in significant cover. California hazel and huckleberry are the most common understory shrubs, with shrub cover usually sparse to moderate. Sword fern may dominate the herbaceous layer.

Because this vegetation type is typified by its two dominant species, each is described in more detail below.

Douglas-fir (*Pseudotsuga menziesii*)
Coast Douglas-fir is a large, coniferous, evergreen tree. Trees 5 to 6 feet in diameter and 250 feet or more in height are common in old-growth stands. Trees often live more than 500 years and occasionally more than 1,000 years. Douglas-fir is shade intolerant and requires stand-destroying disturbance (e.g., wildfire, logging, extensive windthrow) to initiate a new cohort of seedlings. This species is extremely long-lived. Stands 350 to 750 years old are subclimax and may contain a significant component of Douglas-fir for several more centuries. Without disturbance, these stands will give way to shade-tolerant associates such as western hemlock, western red cedar, and Pacific silver fir, but it may take 1,000 or more years for Douglas-fir to be fully replaced. This longevity allows Douglas-fir to persist until the next disturbance, ensuring a seed supply for postdisturbance establishment.

Coast Douglas-fir can survive moderately intense fires. Thick, corky bark on the lower bole and roots protects the cambium from heat damage. In addition, tall trees have their foliage concentrated on the upper bole, which makes it difficult for fire to reach the crown; however, it should be noted that trees are typically not free of lower branches up to a height of 33 feet until they are more than 100 years old. Additionally, many stands in the project area have substantial ladder fuel accumulations, which could result in crown fire.

Crown fires will commonly kill Douglas-fir trees over extensive areas. Rapidly spreading crown fires inflict damage to crowns, while slow spreading ground fires damage the boles and kill trees through cambial heating. Early or mid-summer fires are more damaging than late summer or fall fires because more buds are killed through crown scorching. During late summer buds are set and subsequent year needles are well-protected. Seedlings and saplings may be killed by even low intensity ground fires. Most seeds on the forest floor are killed by fire, but green cones are relatively well insulated and are not highly flammable. If cones are just scorched in a fire, seeds can mature in the cones and disperse onto the burned area.

Coast Redwood (*Sequoia sempervirens*)
Coast redwood is endemic to northern California and southwestern Oregon coastal areas. The trees occur on a narrow strip of land approximately 450 miles long and 5 to 35 miles wide. Coast redwood is a native, evergreen, long-lived (greater than 2,200 years) tree. Redwoods are among the world's tallest trees; trees over 200 feet are common, and many are over 300 feet. The largest tree measured to date was 364 feet tall and 20 feet in dbh. The tree's root system is composed of deep, widespreading lateral roots with no taproot. The bark is up to 12 inches thick and quite fibrous. Redwood self-prunes well in dense stands, and the base of the bole is strongly buttressed.

<u>Hardwood Forest.</u> This type of forest is comprised of hardwood species such as California bay (*Umbellularia californica*), coast live oak (*Quercus agrifolia*), eucalyptus (*Eucalyptus globulus*), tanoak (*Lithocarpus densiflorus*), madrone (*Arbutus menziesii*), and giant chinquapin (*Chrysolepis chrysophylla*). California bay is by far the most abundant, comprising roughly 75% of trees in this type of forest. Coast live oak makes up about 20%; these two species often associating with each other. Of the remaining forest, less than 5% is eucalyptus, and tanoak, madrone and giant chinquapin each comprise less than 1% of tree densities

California bay forest canopy is dominated by California bay or co-dominated by bay and coast live oak with each species comprising 30-60% relative canopy cover. Tanoak, Douglas-fir (*Pseudotsuga menziesii*) and California buckeye (*Aesculus californica*) may also have a significant presence. The understory is variable; it can be a moderately dense shrub understory often dominated by hazel (*Corylus cornuta*), coffeeberry (*Rhamnus californica*), elderberry (*Sambucus racemosa*) and/or poison oak (*Toxicodendron diversilobum*). If there is no significant shrub cover, swordfern (*Polystichum munitum*) usually dominates understory.

Coast live oak woodlands are dominated by coast live oak usually with a significant component of California bay, sometimes co-dominating with bay. Individual Douglas-firs may be present. Understory is usually open to moderate with poison oak being the most commonly found shrub, often fairly high in cover. Coffeeberry, coyote brush (*Baccharis pilularis*), toyon (*Heteromeles arbutifolia*) and hazel can be present. Herbaceous cover is usually low.

California Bay (*Umbellularia californica*)

California bay occurs in the Klamath, Siskiyou, and Coast Ranges from Douglas County, Oregon south to San Diego County, California, and on the western slope of the Sierra Nevada from Shasta County south to Kern County. It grows along drainages in California's Central Valley. It occurs from sea level to 4,000 feet in northern California and Oregon and from 2,000 to 5,000 feet in southern California.

A highly branched native evergreen tree, California bay grows from 40 to 80 feet tall. It grows in scrub form on poor sites. California bay begins reproducing by seed at 30 to 40 years. Seed crops are abundant in most years. Germination and establishment are favored in riparian areas where seed is buried by silt deposition or high water. Seedlings are good competitors against other species and grow under moderately dense canopies. Seedling recruitment, however, is poor under other California bay trees. California bay sprouts from the root crown, bole, or stump.

Coast Live Oak (*Quercus agrifolia*)

Coast live oak occurs along the Coast, Transverse, Peninsular, and Sierra de Juarez ranges from Mendocino County, California, south to Baja California. Limited inland populations occur along watercourses in California's Central Valley. Coast live oak also is found on the Channel Islands of Santa Rosa and Santa Cruz.

Coast live oak is a frequent dominant or codominant in mixed evergreen forests in the project area where it grows with tanoak, Pacific madrone, California bay, and coast Douglas-fir. Elevations of coast live oak populations range from sea level to 3,000 feet in central and northern California.

Coast live oak is a drought-resistant, evergreen tree, ranging from 19 to 82 feet tall and from 1 to 4 feet in diameter. The bark of young trees is smooth, and it develops deep furrows and ridges with age. The inner bark and cork layers are thick. Open-grown crowns are broad and dense, with foliage often reaching the ground. In open areas trunks are usually 4 to 8 feet tall; at this height, primary branches originate and grow horizontally. Coast live oak stands are typically from 40 to 110 years old, and individual trees may live over 250 years. Coast live oak may grow where it can access groundwater, but most individuals have extensive shallow root networks.

Ecologists refer to changes in the grassland, chaparral, and oak woodland mosaic of California as "non-directional fluctuations" rather than succession. Coast live oak may be considered seral or climax depending on habitat, but it is tolerant of shade throughout its life. Because deer and cattle prefer coast live oak, it is gradually replaced by California bay in some areas of coastal northern California where the two species codominate.

In burned or logged mixed evergreen forest, a coast live oak phase is seral to the climax forest. However, on steep slopes or poor sites within this habitat type, coast live oak represents a topographic or edaphic climax. In the San Francisco Bay area coyote brush invades grasslands, and coyote brush subsequently facilitates coast live oak woodland development. In the absence of disturbance, coyote brush scrubland almost always gives way to coast live oak and California bay, as coyote brush seedlings do not develop beneath their own canopies.

Coast live oak is exceptionally fire resistant. Adaptations include evergreen leaves, thick bark, and sprouting ability. Evergreen leaves allow this species to allocate greater amounts of energy to recovery from fire than to replacing the entire crown annually. Evergreens are often better able to conserve nutrients than deciduous species, and are favored in fire-prone environments. Coast live oak bark is the thickest among California oaks. Oaks are more likely to be damaged by fall fire than earlier fires. Because of mortality among small-diameter trees, frequent fire limits coast live oak invasion of grasslands.

Eucalyptus (*Eucalyptus spp.)*

Eucalyptus is notable because it is an invasive non-native hardwood species in the park, and would be treated in some alternatives by thinning and herbicide application to prevent stump resprouting. Eucalyptus forests are dominated by the non-native Blue gum eucalyptus which have been planted in or have invaded native plant communities. Eucalyptus is usually highly dominant in the canopy. Monterey pine (*Pinus radiata*)/Monterey cypress (*Cupressus macrocarpa*) or individuals of Douglas-fir, California bay or coast live oak may be present. Understory is usually sparse often including remnants of the native community. Poison oak and non-native or native berries (*Rubus spp*.) are common shrubs. Other non-native shrubs and herbs are often present in low cover. The floor of the eucalyptus forests is characterized by a thick layer of litter made up of bark, seedpods, leaves and branches.

Monterey Pine/Monterey Cypress (*Pinus radiata/Cupressus macrocarpa*)

Monterey pine is an evergreen conifer. The typical variety of Monterey pine occurs along the California coast in three disjunct populations in San Mateo, Santa Cruz, Monterey, and San Luis Obispo counties. The Monterey pine trees in the project area were introduced.

Monterey pine is cultivated for timber in numerous countries. Much of the Monterey pine planted as ornamentals comes from New Zealand stock. This stock originated from native California populations several generations ago. In Cambria and Monterey, California, this imported stock is crossbreeding with native individuals. Monterey pine also hybridizes with knobcone pine and Bishop pine. The genetic effect of this crossbreeding on native trees is unknown, and preserving genotypes of native individuals is of management concern.

Monterey pine attains a height of 49.5 to 115.5 feet and a dbh of 24 to 36 inches. The tree's outer bark is narrowly ridged and the inner bark is resinous. The needles occur in clusters of three and are 4 to 6 inches long. They persist for approximately three years. Cones are 3 to 5.5 inches long and occur in one or more clusters of three to five around the branch. Monterey pine lives a maximum of 80 to 90 years.

The minimum seed-bearing age for Monterey pine is between 5 and 10 years. Maximum seed production begins at 15 or 20 years of age if trees are open-grown, and later if stands are dense. Cones are produced annually, with good cone crops produced every other year. Mature cones remain attached to the branch. They may remain closed for several years, depending on temperature and humidity. Cones open and release seed during warm, dry periods and close rapidly when temperature drops and relative humidity increases. Seedfall is heaviest in warm, dry years. Unreleased seed remains viable for decades. Seeds from cones up to 24 years old have germinated; but germination appears to fall off with progressing years. Seedling recruitment is best on mineral soil. Monterey pine does not reproduce by sprouting.

Monterey pine cones are serotinous; seeds are released when cones are exposed to heat such as fire or high air temperature. Fire is particularly effective for opening cones and releasing seeds and it creates a favorable seedbed. Reproduction rates are greatest after surface fire in which the parent trees survive. Monterey pine is killed by severe surface or crown fire. Trees survive crown scorch, however, unless it is extensive. Young, thin-barked Monterey pine are often killed by fire, particularly when stands are dense and crown fire occurs.

Monterey cypress (*Cupressus macrocarpa*) occurs in two natural stands in Monterey County, California. One stand is between Point Cypress and Pescadero Point on the north side of Carmel Bay, Monterey Peninsula. A smaller one is near Point Lobos on the south side of Carmel Bay. Monterey cypress is widely planted and naturalized on the California coast. The Monterey cypress in the project area were introduced.

Monterey cypress is an evergreen tree that grows to 82 feet tall. The bark is thick and fibrous, becoming furrowed with age. A well-defined taproot and numerous laterals are formed the first year. Naturalists at the Point Lobos State Reserve have estimated the maximum age of Monterey cypress at 200 to 300 years.

<u>Riparian Woodland.</u> These streamside forests and shrublands are dominated by broad-leaved deciduous trees or shrubs such as red alder (*Alnus rubra*), mixed willows, and arroyo willows (*Salix lasiolepis*). Red alder forest is the most abundant of this type comprising approximately 70% of riparian areas. Understory is usually moderate to dense. Berry species (salmonberry- *Rubus spectabilis*, thimbleberry- *R. parviflorus*, California blackberry- *R. ursinus*) and red elderberry (*Sambucus racemosa*) are the common shrubs. Hedgenettle (*Stachys ajugoides*), sedges (*Carex spp*.), rushes (*Juncus spp*.), small-fruited bulrush (*Scirpus microcarusp*) and ferns (sword fern- *Polystichum munitum*, lady fern- *Athyrium felix-femina*) dominate the herbaceous layer.

Other forested riparian areas are dominated by mixed willow forest, represented in the project area by yellow willow (*Salix lucida*), often associating with other willows. Mixed willow forest makes up less than 5% of riparian areas.

Arroyo willow shrublands make up approximately 25% of the riparian type. Arroyo willow in its shrub form stands between 16 and 23 feet high (5 to 7 meters), and strongly dominates the canopy. Other taller willows or alder may be present in small quantities. The understory is usually extremely dense because of the thicket- forming growth habit of this species. Shrubs such as berry species (*Rubus parviflorus*, *R. spectabilis*, *R. ursinus*) are most commonly found woven through the understory. Wax myrtle (*Myrica californica*) or poison oak (*Toxicodendron diversilobum*) may be present. Sedges, rushes, small-fruited bulrush along with hedgenettle, beeplant (*Scrophularia californica*) and the ferns (Lady fern, bracken fern- *Pteridium aquilinum*) dominate the herbaceous layer. Because they are dominant species in PRNS riparian woodlands and shrublands, red alder and arroyo willow are described in more detail below:

Red Alder (*Alnus rubra*)
Red alder occurs from southeast Alaska to southern California. Red alder communities were primarily restricted to streams and wet areas during presettlement times. Since then, disturbances such as logging have provided an abundance of open sites with bare mineral soil, which favor red alder colonization.

Red alder grows in humid coastal climates characterized by cool wet winters and warm dry summers. Trees need more than 25 inches of precipitation annually, and most stands receive over 40 inches. Red alder is a rapidly growing, short-lived, medium-sized, deciduous tree, generally with one straight distinct trunk. It reaches a maximum height of about 120 feet, with a maximum trunk diameter of about 32 inches. Mature trees are typically from 80 to 100 feet tall and 14 to 18 inches in diameter. Maximum age is one hundred years.

Red alder regenerates primarily by seed. Plants are monoecious and primarily are wind pollinated. Flowering generally occurs from late February to early May depending on latitude and climate.

Seed dispersal begins soon after ripening in late summer, but most seeds are shed during fall and winter. The seeds are very lightweight and are normally carried up to several hundred yards in the direction of the prevailing winds. Seed production begins at about 10 years (but sometimes sooner), and continues throughout maturity, with optimum production at about 25 years of age. A prolific seeder, red alder produces peak crops about every four years, with moderate to light crops produced in between. Total seed crop failure is very rare.

Germination is best on moist mineral soil in full sunlight. Seed also germinates well on rotten wood and duff, and to a lesser extent on soil organic horizons and on rock-surfaced logging roads, but the roots must quickly reach a moist nutritious substrate if seedlings are to survive. Sunlight is required for germination. Seeds under thick vegetation or buried deeply in the soil, will not germinate until the site is disturbed, exposing the seeds to sunlight. Germination percentages range from 59 to 84 percent. Seeds remain viable in storage for about three years.

Red alder is an early seral species. It quickly invades forest openings, such as those created from fires, logging, wind throws, or road cuts, and it also pioneers volcanic mud flows. Plants often reach 6 to 18 inches in 1 year and may reach 18 feet in 5 years. This rapid juvenile growth gives the shade-intolerant red alder a competitive edge over conifers, as it quickly overtops them.

Red alder and Douglas-fir are reported as the principal pioneer tree species of lower and middle elevation forests from southwestern British Columbia to northwestern California. Thus they often dominate the first postfire community. Disturbed areas are naturally seeded, resulting in stands that start out with several thousand alder trees per acre. Due to red alder's shade intolerance, stands are self-thinning; trees that do not maintain their height in the canopy die, resulting in even-aged stands. Conifers such as Douglas-fir that become established at the same time are quickly overtopped by this extremely fast growing species. These early seral red alder communities suppress competing conifers, but after about 25 years, conifers equal red alder height and begin to overtop them. After about 40 years, Douglas-fir becomes dominant. Few red alder trees remain in stands past 60 years. As stands develop and trees mature, they prevent other red alder seedlings from becoming established, due to the seedlings' shade intolerance.

Information regarding the effects of fire on red alder generally is lacking. Red alder's bark, although thin, is sufficiently fire resistant to protect trees from light surface fires. The foliage and leaf litter do not carry fires well. Red alder stands often lack flammable understory debris and are often on moist sites which burn infrequently. Red alder revegetates burned areas via seed from off-site plants.

Red alder quickly invades burned areas. Off-site plants inhabiting fire resistant draws and streambeds provide an abundance of seed, which reportedly can travel several hundred yards via wind. Thus red alder quickly colonizes soils exposed after forest fires. Information regarding the sprouting response of red alder after above-ground plant parts have been killed by fire is lacking. However, response after cutting shows that red alder tends to sprout at the root collar or along the lower stem no matter where the stem is cut. Fire hazard is generally low in red alder stands and stands may be used as natural firebreaks.

Arroyo Willow (*Salix lasiolepis*)
Arroyo willow is a common shrub or small tree (<10 m tall) that occurs in streambeds and on riverbanks below 7000 feet. It occurs in the western United States, from Washington and Idaho south to Texas and Mexico. This species is abundant along shorelines, marshes, meadows, and springs. Flowers are produced from February to April.

Most willows resprout from the root crown or stem base following fire. Severe fires can completely remove organic soil layers, however, leaving willow roots exposed and charred, thus eliminating basal sprouting. Severe fires probably occur infrequently in the moist habitats occupied by arroyo willow. Generally, willows tend to be prolific seeders, and off-site plants are important as a seed source for revegetating burned areas.

<u>Coastal scrub</u> is a highly variable vegetation type including all of the shrublands of the study area and a small amount of chaparral. Coastal scrub is one of the most widespread plant community

types in the project area and is present to some degree in all FMUs. Approximately 90% of coastal scrub is dominated by coyote brush (*Baccaris pilularis*), a small-leaved evergreen shrub. Because it is dominant, it is discussed in more detail below. Coyote brush scrub is highly diverse and variable, ranging from fairly low open areas where coyote brush associates with grasses, to tall dense multi-species scrubs. Coyote brush scrub can be roughly equally divided in the project area between these open and dense variations. In its more open variation, coyote brush commonly associates with non-native and native grasses and California blackberry (*Rubus ursinus*). It may also be found in association with sedges (*Carex spp*.) and rushes (*Juncus spp*.). In its taller, denser variation, poison oak (*Toxicodendron diversilobum*) is the most commonly associating shrub, often in fairly high cover. Coffeeberry (*Rhamnus californica*), thimbleberry (*Rubus parviflorus*), California blackberry and California sagebrush (*Artemisia californica*) are common associates in dense coyote brush scrub.

An additional 5% or so of coastal scrub is dominated by a diverse list of shrub species that includes coffeeberry, yellow bush lupine (*Lupinus arboreus*), hazel (*Corylus cornuta*), and blue blossom (*Ceanothus thrysiflorus*).

Chaparral accounts for less than 5% of the coastal scrub type. The manzanitas (*Arctostaphylos spp*.), primarily Eastwood manzanita (*Arctostaphylos glandulosa*) and chamise, (*Adenostoma fasciculatum*) are the dominant shrubs here. These evergreen species tend to be in the hotter, drier areas with the largest occurrences in the project area found on the western slope of Bolinas Ridge and within the Vision Fire burn area on Inverness Ridge.

Coastal sage and coastal scrub community types are fire-dependent, with prominent shrubs establishing by seed and sprouting. They are flammable vegetation types that may burn again 1 to 2 years after fire if dry conditions exist. With fire in less than 5-year intervals, or with overgrazing, coastal scrub generally reverts to annual non-native grassland. Fire exclusion in coastal sage scrub and mesic chaparral communities allows coast live oak, California bay, and other shade tolerant species to increase in density and reduce understory diversity and abundance. In the absence of fire, coast live oak recruitment in chaparral and grassland is commensurate with their aerial extents; in coastal sage scrub, however, coast live oak recruitment exceeds that expected by chance alone. This is primarily because coyote brush is a nurse shrub for shade-tolerant tree seedlings, particularly coast live oak and California bay. With tree development, coyote brush is reduced or excluded.

Coyote brush (*Baccharis pilularis*)
Coyote brush occurs in the outer Coast Ranges from northern Baja California, Mexico, and San Diego County, California, north to Tillamook County, Oregon. The species occurs in the Channel Islands and as isolated populations in the Cascade and Sierra Nevada foothills from Butte County to Tuolumne County, California. It is a dominant shrub in northern coastal scrub communities and a minor component of coastal beach communities, coastal sage scrub, chaparral, foothill woodlands, closed-cone pine forests, and mixed-evergreen forests.

Coyote brush grows a taproot up to 10.5 feet long; lateral roots are also well developed. Individuals live 10 to 15 years, but basal sprouting and layering may extend this lifespan. Seeds germinate well on mineral soil and have no stratification or temperature requirement. Most germination occurs within about 15 to 30 days. Coyote brush sprouts from the root crown and roots. It may also grow roots where branch nodes contact soil.

Coyote brush is shade-intolerant. Along with other small-seeded coastal sage shrubs, it colonizes actively eroding or alluviating areas such as dunes and gravel bars. Exposed mineral soil gives coyote brush an advantage over perennial grasses and chaparral shrubs. Coyote brush's successional status varies with habitat type. In California grasslands, it is a late seral species that invades and increases in the absence of fire or grazing. Coyote brush invasion of grasslands is of structural importance because it facilitates the establishment of other coastal sage species. Shrub cover subsequently increases numbers of rabbits and small mammals that reduce herbaceous vegetation and favor shrub development. Thus, well-established coyote brush stands generally have depauperate understories. Coyote brush is a common dominant in coastal sage scrub, but because seedling growth is poor in shade, coyote brush does not regenerate under a closed shrub canopy. Coast live oak, California bay, or other shade tolerant species replace coastal sage scrub and other coyote brush-dominated areas, particularly when fire and grazing are excluded. Generally the transition from coyote brush-dominated scrub to mixed evergreen forest takes place in about 50 years and is reversible with periodic fire.

Coyote brush is moderately fire tolerant. In areas of high shrub density, heat at root crowns is often too low to cause mortality, and coyote brush is able to resprout. Fires in such communities reduce crown cover but are not likely to reduce shrub density. Fires that occur in areas with low shrub density and high herbaceous biomass create enough heat at the root crown to girdle and kill plants. In oak woodlands and chaparral, most postfire recovery of coyote brush and other dominants is by sprouting. In coastal sage scrub, fire creates canopy gaps with exposed mineral soil that allow coyote brush and other coastal sage scrub species (most of which also have small, light seeds) to establish from seed and outcompete herbaceous vegetation.

Fire frequency largely determines the extent of grasslands, coastal sage scrub, chaparral, and oak woodlands and whether or not coyote brush is present in each of these types. In grasslands, low fire frequency permits establishment of coyote brush and the gradual exclusion of herbaceous species. In coastal sage scrub, chaparral, and oak woodland, decreasing fire frequency allows coyote brush to be replaced by more shade-tolerant species. In mixed evergreen forests, closed-cone pine stands, and coast Douglas-fir stands, coyote brush is only important in early seral vegetation after fire or logging. Transition from coyote brush scrub to mixed evergreen forest can occur in 50 years without fire. In some cases, however, tree recruitment is limited by crown closure, and fire exclusion does not result in type conversion but rather maintenance of a dynamic mosaic wherein reversion and succession allow both vegetation types to persist.

Fire exclusion in coastal prairie allows coyote brush establishment, with best establishment in wet years. Prescribed burning has been used in coastal prairie to reduce invasion of coyote brush and other shrubs.

In coastal sage scrub, prescribed fire reduces fuel loading, risk of property-damaging wildfire, and the establishment of coast live oak and other trees. Mature coyote brush stands in coastal sage scrub are generally replaced by shade-tolerant species, and maintenance of coastal scrub, if desired, requires periodic disturbance. Grazing and/or prescribed fire have been recommended where the management objective is grassland maintenance.

Grassland. Pristine coastal prairie in the study area is dominated by perennial bunchgrasses, but roughly 80% of the grasslands in the Seashore are dominated by non-native grasses. Most common is the invasive perennial purple velvet grass (*Holcus lanatus*), although annual Italian wild rye (*Lolium multiflorum*), farmer's foxtail (*Hordeum murinum*) and rattail fescue spp. (*Vulpia spp*.) also cover large acreage.

Pacific reedgrass (*Calamagrostis nutkaensis*) is the most common native grass in the project area, along with tufted hairgrass (*Deschampsia cespitosa*), California oatgrass (*Danthonia californica*), meadow barley (*Hordeum brachyantherum*), and California brome (*Bromus carinatus*). Where Pacific reedgrass is in association with rushes (*Juncus spp*.) and sedges (*Carex spp*.), it is included in the wetland vegetation type. Native grasses are often found in association with annual non-native grasses, coyote brush, California blackberry and a variety of native and weedy herbs.

Pasture is distinguished from grazed grasslands and other grazed naturally occurring vegetation types in the project area as it is used to graze cattle or horses, or managed to produce silage for cattle, or used for other agricultural purposes. The Minimal Management FMU is predominately pasture.

Coastal Dunes - The majority of dune habitat is dominated by non-native species. The western portion of the Linamtour FMU has the most extensive areas of coastal dunes; smaller patches are present in the Headlands and Tomales Point FMU. Non-native European beachgrass (*Ammophila arenaria*) represents roughly 50% of the coastal dune vegetation, and non-native iceplant (*Carpobrotus edulis*), roughly 25%. In areas where these two species dominate, they form dense monocultures, with few or no other species present.

The remaining 25% of this vegetation type are remnant patches of native plant community comprised primarily of dune sagebrush (*Artemisia pycnocephala*), coast buckwheat (*Eriogonum latifolium*), dune lupine (*Lupinus chamissonis*), or goldenbush (*Ericameria ericoides*), often with significant cover of the two invasive species - European beach grass and/ or iceplant. Total vegetation cover is often low and interspersed with bare sand.

Wetlands

This vegetation class includes moist herbaceous wetlands, salt marshes and freshwater marshes. Moist herbaceous wetlands, dominated by rushes (*Juncus* spp.), sedges (*Carex* spp.), small-fruited bulrush (*Sirpus microcarpus*) and Pacific reedgrass (*Calamagrostis nutkaensis*) in association with these wetland species, make up approximately 70% of this type. Any of these species may dominate and may often be found in swales in a patchwork pattern. Other associating species include purple velvet grass (*Holcus lanatus*) and California blackberry (*Rubus ursinus*) in the drier areas, potentilla (*Potentilla anserina*), hedgenettle (*Stachys ajugoides*), lady fern (*Athyrium felix- femina*), and horsetail (*Equisetum* spp.) in the moister areas.

Table 13. Marsh and Other Wetland Acreage in each FMU Where Management Would Take Place

FMU	Acreage
Tomales Point	74.3
Headlands	7.7
Estero	94.2
Inverness Ridge	13.4
Limantour Road	69.7
Wilderness North	2.6
Wilderness South	22.4
Highway One	13.4
Bolinas Ridge	0
Palomarin	25.2
TOTAL	322.9

Salt marshes make up roughly 30% of wetlands in the project area. Pickleweed (*Salicornia virginica*) is the most common dominant, as well as saltgrass (*Distichlis spicata*); these species often co-dominate. Jaumea (*Jaumea carnosa*) is the most common associate. Sea lavender (*Limonium californicum*), arrow-grass (*Triglochin concinna*), alkali heath (*Frankenia salina*) and bird's beak (*Cordylanthus maritimus*) are often associates as well.

Freshwater marshes account for less than 5% of this type. Dominant species are the tall California bulrush (*Scirpus californicus*) and cattails (*Typha* spp.). These species are found in the wettest areas in or at the edge of standing water such as marshes or stock ponds. Bur-reed (*Sparganium* spp.) and water parsley (*Oenanthe sarmentosa*) are common associates.

Wildlife

The project area supports a wide diversity of wildlife species, including 28 species of reptiles and amphibians, 65 species of mammals, and breeding habitat for 130 species of birds. Nearly 490 bird species (representing 45% of the avian fauna documented in the United States) have been sighted on land and over near shore waters at Point Reyes. PRNS is also home to innumerable invertebrates. The waters of the Pacific Ocean and Tomales Bay support rich and diverse fisheries. Many of the wildlife species present in the study area are listed by the federal or state endangered species acts as threatened or endangered by extinction from all or part of their range.

Mammals

A rich diversity of terrestrial mammals occupies the many habitats presented in the 10 Fire Management Units. More common mammalian species include dusky-footed woodrat (*Neotoma fuscipes monochroura*), bobcat (*Lynx rufus*), gray fox (*Urocyon cinereoargenteus*), black-tailed deer (*Odocoileus hemionus columbianus*), raccoon (*Procyon lotor*), striped skunk (*Mephitis mephitis*), black-tailed hare (*Lepus californicus californicus*), brush rabbit (*Sylvilagus bachmani ubericolor*) and many species of bats, shrews, mice and moles. Mountain lion (*Felis concolor*) are present though rarely seen and coyotes (*Canis latrans*) are widespread. Tule elk (*Cervus elaphus nannodes*), once extirpated from the Peninsula, have been successfully reintroduced. They are a regular presence in several of the FMUs and are especially numerous in the Tomales Point FMU.

The many marine mammals that inhabit or transit in the waters off of Point Reyes would not be affected by actions proposed in the Fire Management Plan and are therefore not described as part of the Affected Environment. FMP actions in each alternative have been developed to ensure marine mammal areas are not impacted by smoke produced from a prescribed fire.

Amphibians and Reptiles
Large populations of the California red-legged frog (*Rana auroura draytonii*) occur within the project area (see below). More common amphibians in the project area include bullfrogs (*Rana caesbeiana*), California newts (*Taricha torosa*), Pacific treefrog (*Hyla regila)* and rough-skinned newts (*Taricha granulosa*). It is not uncommon to find the Pacific giant salamander (*Dicamptodon enstatus*) near streams.

Common reptiles include the Western fence lizard (*Sceloporus occidentalis*), Northern alligator lizard (*Gerrhonotus coeruleus*), Pacific gopher snake (*Pituophis melanoleusus*), Western terrestrial garter snake (*Thamnophis elegans*) and Western pond turtle (*Clemmys marmorata*).

Birds
Located along the Pacific Flyway and prominently jutting from the coast, the Point Reyes Peninsula supports a large number of resident and migratory birds. Though nearly 490 bird species have been documented at PRNS over half of the sightings were considered rare or extremely rare occurrences (i.e., unusual for this area). The project area provides breeding habitat for over 100 bird species. The park is recognized as a site of global significance for birds because of the great diversity and abundance of species. Some of the species of particular note that are resident and nesting include northern spotted owls, osprey, various raptors and owls, Neotropical migrant songbirds, several species of seabirds such as ashy storm-petrel, and western snowy plovers. Examples of significant migratory species include the Neotropical migrant songbirds, raptors, and brown pelicans.

Fish
Several important anadromous fish species are present in the creeks and watersheds within the study area. Anadromous species are those that migrate from the ocean to brackish or fresh water habitat to breed. Species present within the study area include coho salmon (*Oncorhynchus kisutch*) and steelhead trout (*Oncorhynchus mykiss*), an anadromous rainbow trout. Both species are listed as threatened under the federal Endangered Species Act (see below). The coho returns to the stream in which it was born to breed after spending two years in the open ocean. The Lagunitas Creek watershed population is host to one of the largest remaining populations in the central coast of California. Steelhead trout occur in most perennial watersheds in the study area (Ketcham, 2001). Other anadromous fish species include herring, the Pacific lamprey (*Lampertra tridentata*), a federal Species of Concern, the green sturgeon (*Acipenser medirostris*), a federal Candidate Species, the California roach (*Hesperoleucus symmetricus*), a state Species of Concern.

Non-native wildlife
Several species of non-native wild and feral animals also occur in the project area. Axis deer (*Axis axis*) and fallow deer (*Dama dama*) were released in the 1940s and 1950s by a local landowner for hunting. Non-native and feral predators, such as red fox (*Vulpes vulpes*), Norway rat, possum and house cats (*Felis domesticus*) are present, as well as several non-native bird species including house sparrows, European starlings, wild turkeys (*Meleagris gallopavo*), and common peafowl (*Pavo cristatus*).

Special Status Species

The study area supports 47 listed animal species - 14 are federally listed as endangered, 8 as threatened and 24 as Species of Concern. Among these are the endangered Brown Pelican (*Pelecanus occidentalis*) and Myrtle's silverspot butterfly (*Speyeria zerene myrtleae*). Federally threatened species include Northern spotted owl (*Strix occidentalis*), Western snowy plover (*Charadrius alexandrinus*), and the California red-legged frog (*Rana aurora draytoni*). Nineteen federally listed plant species (seven of which also are state listed) and an additional 25 listed or proposed for listing by the California Native Plant Society (CNPS) have been documented in the study area (Table 3).

Many of the plant and wildlife species present in the project area are regulated or monitored by the US Fish and Wildlife Service (USFWS), National Marine Fisheries Service and/or the State of California. Regulatory protection is afforded to species listed or proposed as threatened or endangered under the federal and state endangered species acts, the Marine Mammal Protection Act and the Migratory Bird Treaty Act. Species listed as Species of Concern by the US Fish and Wildlife Service, and Species of Special Concern by the California Department of Fish and Game, do not have legal protection under Endangered Species Act but are considered as species with potential to require future listing. Rather, the listing as species of concern brings these species to the attention of the public and appropriate agency with the aim of obviating the need for future listing through wise management practices.

This section is divided into a discussion of plants that are listed under the Endangered Species Act (Federally listed species), plants that are listed as Species of Concern by the USFWS or on California state lists only (Other Special Status plant species). Tables 3, 15, 21, and 22 list all plant special status species, and Tables 24 and 33 animals species with special status.

Federally Listed Plant Species
Federally listed plants in the study area that may be affected by fire management activities include Sonoma alopecurus (*Alopecurus aequalis* var. *sonomensis*), Sonoma spineflower (*Chorizanthe valida*), robust spineflower (*Chorizanthe robusta*), Tiburon paintbrush (*Castilleja affinis* ssp. *neglecta*), Marin dwarf flax (*Hesperolinon congestum*), beach layia (*Layia carnosa*) and Tidestrom's lupine (*Lupinus tidestromii [*var. *layneae*]). These species are described below.

Sonoma alopecurus (Alopecurus aequalis var. sonomensis) – Endangered
Sonoma alopecurus is a perennial grass 9-47 cm tall that has spike-like flowers. It is a variety of the species found in wet meadows and shorelines in California, the eastern U.S., and Eurasia.

Because alopecurus individuals flower at different times throughout late spring and early summer within a given site, it is difficult to accurately estimate numbers of plants.

Four occurrences of this species are currently known on the Point Reyes peninsula, all occurring within pastures on agricultural permit lands (Table 14). Two occur in the vicinity of Abbott's Lagoon, on the G and H ranches, another on the F Ranch, and the fourth on a private in-holding within the PRNS owned by American Telephone and Telegraph (AT&T).

All occurrences are within the low-lying coastal plain that occupies most of the west-central Point Reyes peninsula. Soils in these areas are of the highly sandy Sirdrak and Sirdrak variant series, the latter characterized by a weakly cemented discontinuous hardpan producing a seasonal high water table, which can support robust growth of wetland species such as small-fruited bulrush (*Scirpus microcarpus*) and bog rush (*Juncus effusus*). While the present range of this taxon within PRNS is restricted to sandy soils, the distribution of the taxa as a whole suggests that it could occur, or could have occurred in the past, in wetland sites dispersed over much of PRNS.

Table 14. *Sonoma alopecurus* Occurrences and Numbers of Plants from 2000-2003

	2000	**2001**	**2002**	**2003**
G Ranch	1,572	3,405	7,530	8,386
H Ranch	60-328	648	129	661
F Ranch	53	336	340	1,042
AT&T				
Sub- occurrence 1	470	289	400	1,843
Sub- occurrence 2	1,696	243	800	1,774

Table 15. Federal Threatened, Endangered, Candidate, and Proposed Plant Species that may occur in Areas Affected by PRNS's Fire Management Plan (per USFWS Letter, May 24, 2001).

Common Name	**Scientific Name**	**Listing Status**[a]	**Known to Occur**	**Potentially Subject to Adverse Impacts**
Sonoma alopecurus	*Alopecurus aequalis* var. *sonomensis*	E	yes	yes, but unlikely [b]
Tiburon paintbrush	*Castilleja affinis* ssp. *neglecta*	E	yes	yes, but unlikely [b]
Robust spineflower	*Chorizanthe robusta* var. *robusta*	E	yes	no
Sonoma spineflower	*Chorizanthe valida*	E	yes	yes, but unlikely [b]
Baker's larkspur	*Delphinium bakeri*	E	no	no
Marin dwarf flax	*Hesperolinon congestum*	T	yes	yes, but unlikely [b]
beach layia	*Layia carnosa*	E	yes	no[c]
Tidestrom's lupine	*Lupinus tidestromii (*var. *layneae)*	E	yes	no[c]

showy Indian clover	*Trifolium amoenum*	E	extirpated	no

a Listing status: E: Endangered T: Threatened

b These species do not occur within any of the FMUs except the Minimum Management Unit (where prescribed fire and mechanical treatments would not occur). The grazed grassland and wetland (Alopecurus) habitats supporting these species are unlikely to be affected by unplanned wildfire.

c These species occur in coastal dunes, which is part of the Minimum Management Unit (where prescribed fire and mechanical treatments would not occur). The dune habitats supporting these species are very unlikely to be affected by unplanned wildfire

The G Ranch occurrence is located in a back dune area near the southwest corner of Abbott's Lagoon, in a swale that supports freshwater marsh vegetation. The swale is located along a fence built in 1989 to exclude cattle from the shores of the lagoon and from the dunes west of Abbott's Lagoon. The occurrence numbered 33 plants in 1994, 38 plants in 1995, and 40+ plants in 1998. In June, 2000, a more thorough and systematic survey than previously conducted documented a peak population size of 1,572 individuals.

The H Ranch occurrence is in a freshwater marsh/swale along a fence that borders an ungrazed area south of Abbott's Lagoon. The fence was built in 1983 to keep cattle away from the eastern, freshwater lobe of Abbott's Lagoon and from a trail running from Pierce Point Road to the beach. Alopecurus was sown in a part of the swale excluded from grazing after the fence was constructed. This fenced location is now overgrown with dense native wetland vegetation and no alopecurus is present. The site that does presently support plants, within the pasture, is immediately above a small berm carrying the trail across the swale. The berm may have altered the hydrology above it, making it wetter and more favorable for alopecurus, while cattle may remove competing taller wetland plant species. This occurrence was most recently surveyed several times over the summer of 2000, with plant numbers varying from 60 to 328 individuals.

The third occurrence was newly discovered on F Ranch in 2000, in a wetland swale between semi-stabilized dunes. This occurrence supported 53 individuals when a census was conducted in July, 2000. This survey, however, was done late in the blooming season and may not have included all of the alopecurus present.

This alopecurus occurrence is located on land that was recently purchased by the NPS from AT&T. This 521-acre tract previously served as a base for telecommunications transmission and reception, and has limited development of facilities. Poles bearing transmission wires are scattered over part of the parcel, and only minimal ground disturbance for maintaining poles takes place. The land is leased to one of the PRNS ranchers for cattle grazing. The two sub-occurrences located on this tract supported a total of over 2,100 plants when last surveyed in May and July, 2000.

One historic colony of Sonoma alopecurus, located in a pasture near Mesa Road north of Bolinas, has been extirpated since rare plant monitoring began in the park in 1983. Following exclusion of cattle from the site by fencing in 1985, it became overgrown with wetland and weedy vegetation. Alopecurus was last seen there in July, 1991.

Efforts to establish new occurrences of Sonoma alopecurus in several locations in PRNS took place in the late 1980's at five sites. By 1990, no alopecurus were found in any of these sites.

Results of monitoring of Sonoma alopecurus described above suggest that alopecurus thrives in wetlands that are grazed just enough to reduce competing vegetation. New occurrences of alopecurus may be found in areas of seasonally saturated soils as rare plant surveys continue. Such areas are most common in, but not exclusive to, the relatively gentle topography of the west-central Point Reyes peninsula. In 2002, four new introduction sites were established and are being monitored annually by park staff and volunteers.

Sonoma spineflower (Chorizanthe valida) – Endangered

Sonoma spineflower is an annual, growing 10-30 cm tall on sandy soils. A member of the Buckwheat family, it is named for its stiff involucral awns. It is thought to have originally been widespread in Marin and Sonoma counties, and was believed to have gone extinct during the mid-1900s due to agricultural and urban development. In 1976, the species was rediscovered in PRNS south of Abbott's Lagoon in the same pasture on G Ranch in which Sonoma alopecurus is located. This population has been monitored by CNPS since 1983. These surveys provide only coarse estimates of plant numbers. Survey data show population size ranging from several hundred plants in 1983 to 30,000 plants in 1993 (Table 16). The Marin chapter of CNPS has actively searched other areas for this plant since its 1980 rediscovery without success, and it is considered unlikely that other populations of spineflower will be found. The closely related San Francisco Bay spineflower (*C. cuspidata var. villosa*) is also found at Point Reyes in greater numbers and over a larger area, primarily in dune habitat.

Table 16. Population Estimates for Sonoma Spineflower on G Ranch 1980-2002 (intermittent)

Year	**Estimated Numbers**	**Year**	**Estimated Numbers**	**Year**	**Estimated Numbers**
1980	100	1990	2,000	1998	5,400
1984	1,000	1991	25,000	1999	23,000
1986	2,500	1992	27,000	2000	6,200a
1988	2,500	1993	30,000	2001	16,800a
1989	3,000	1994	7,570	2002	25,300a

a/ Survey of sub-population only.

Monitoring conducted since the mid-1980's has shown that the Sonoma spineflower can experience large variations in numbers from year to year, and estimated plant numbers have ranged from as low as several thousand individuals occupying less than 0.4 acres (0.85 ha) to as high as 30,000.

One of the requirements for downlisting Sonoma spineflower is to establish and maintain two new populations (USFWS, 1998). Several efforts have been made to establish new occurrences from seed within grazed pastures at PRNS. In 1988 seeds were planted in three 2x2 meter plots within 100-200 meters of the existing population. Although reproducing spineflowers initially grew in all three plots, two of the plots eventually failed. The third, however, has expanded outside the original seeded plot and had 690 individuals in 2000. Two smaller seed plots planted near the successful plot had 122 plants between them in 2000.

In 1999, Sonoma spineflower was seeded at F Ranch, in the vicinity of an occurrence last observed in 1903. The site chosen for planting is regularly frequented by cattle to the extent that the soil is disturbed and competing vegetation is well grazed down. Although it is too early to know if the population will persist, 34 plants were counted there in 2000. In 2001, the original seeding had 182 plants, while a second and third seeding made in 2000 had 26 and 0 plants respectively. In 2002 the original seeding had 80 plants, the second and third seeding had 201 and 4 plants respectively. In 2002 an additional three seed plots were installed.

Tiburon paintbrush (Castilleja affinis ssp. neglecta) – Endangered, Marin dwarf flax (Hesperolinon congestum) – Threatened, and Robust spineflower (Chorizanthe robusta var. robusta) – Endangered

Approximately 300 acres at the crest of Nicasio Ridge at the northern border of GGNRA's North District contains serpentine soils and rocky outcrops that support a number of serpentine endemic plant species. Serpentine soils are found on a relatively flat ridgetop, most of which is on private land outside of GGNRA, and on smaller rocky outcrops within GGNRA.

Tiburon paintbrush is a semi-woody perennial, with erect, branched stems 30 to 60 cm (1 to 2 ft) tall. It is known from six locations - one each in Napa and Santa Clara counties, three on Ring Mountain in eastern Marin County, and one on Nicasio Ridge. The Nicasio Ridge occurrence covers approximately 11 acres on the McIssac Ranch in GGNRA and adjoining private ranchland. Tiburon paintbrush grows in association with an evergreen, spiny-leafed ceanothus taxa that may be previously not described. The number of Tiburon paintbrush on Nicasio Ridge was 100 individuals in 1998, 41 in 1999, 84 in 2000, and 68 in 2001. A survey was not conducted in 2002.

Table 17. Monitoring for Tiburon paintbrush (Nicasio Ridge)

Year	**Number of Individuals**
1998	100
1999	41
2000	84
2001	68
2002	No survey

Marin dwarf flax is an annual species growing 5-15 cm tall on serpentine grassland from Marin to San Mateo counties. It is known from six locations on Nicasio Ridge, with the largest occurrence overlapping with the Tiburon paintbrush area extending along the ridgetop from the McIssac Ranch into private land. The other five occurrences are located on small rocky outcrops on the Cheda, McIssac, and Zanardi ranches. Abundance of Marin dwarf flax on Nicasio Ridge appears to vary widely from year to year (Table 18). Survey efforts in 1998-2000 were the same but the number of occurrences and estimates of individual plants differed substantially, with new occurrences found in 1999 and 2000. This suggests the distribution of Marin dwarf flax on Nicasio Ridge is not fully known, and it may appear in other sites in the future due to seed dispersal, weather, or localized disturbances.

Table 18. Occurrences and Estimated Numbers of Marin Dwarf Flax on Nicasio Ridge.

Occurrence	1998	1999	2000	2001	2002
#1	157	87	2,000	178	No survey
#2	56	0	350+[b]	0	No survey
#3	a	2	740	No survey	No survey
#4	a	a	285	No survey	No survey
#5	a	a	350+[b]	130	No survey
#6	a	a	350+[b]	182	No survey

a/ Occurrence not found.
b/ Observers stopped counting at 350 plants.

Beach layia (Layia carnosa) – Endangered; and Tidestrom's lupine (Lupinus tidestromii) – Endangered

These two plant species occur in coastal dunes on the western edge of the PRNS peninsula. Both have been monitored by CNPS volunteers and PRNS staff since the 1980s. Monitoring reports include an estimate of plant numbers, a description of site characteristics, and apparent threats to each occurrence. These reports have been assembled in the PRNS Rare Plant Database (NPS, 2001c).

Beach layia is an annual, usually prostrate member of the Asteraceae family found in 19 dune sites on the northern and central California coast from Humboldt to Santa Barbara counties. It has been recorded at 14 sites within the dunes at PRNS, with estimated numbers of individual plants varying widely among occurrences (Table 19). Its habitat is the central foredune community characterized by some drifting sand and low growing herbaceous and perennial species. Beach layia can experience large fluctuations in plant numbers and local distribution associated with dune blowouts and restabilization. Such fluctuations have been observed in four of the five PRNS occurrences for which counts have been made over multiple years. Five of the thirteen beach layia occurrences at PRNS are located in pastures, but plant monitors did not consider cattle to be a threat to them. Twelve of the occurrences were considered to be threatened by the presence of the non-native European beachgrass (*Ammophila arenaria*), sea fig (*Carpobrotus chilensis*), and/or Hottentot fig (*Carpobrotus edulis*) nearby. These perennial, rhizomatous non-native species form monotypic stands that virtually exclude less competitive native species.

Table 19. Beach layia Occurrences and Estimated Numbers of Plants, 2000-2003.

Population Number	2000	2001	2002	2003
1	2,140	289	>100	3,129
2	250	>1,000	no count	no survey
3	667	no survey	no survey	7,167
4	36a	0	481	687
5	<10	788	no survey	5,199
6	792	>1,000	no count	no surveys
7	632	no survey	>100	no surveys
8	8	no survey	175	583
9	1,879	>1,000	no survey	no surveys
10	350	no survey	>1,000	9,029
11	15,000	349	no survey	no surveys
12	15	no survey	no survey	1,152
no # 13	--	--	--	--
14	664	no survey	no survey	4,427
15b	--	--	no count	8,070
Total	22,433	>4,000	>2,000	39,444

a/ Surveyed in 1988.
b/ New occurrence in 2002.

Tidestrom's lupine is a small (10-30 cm) decumbent shrub found in 11 areas in dunes from southern Sonoma County to Monterey County. It is known from seven occurrences at PRNS, of which four have been monitored since the 1980s by CNPS.

The largest Tidestrom's lupine occurrence is in the large stable plain behind dunes southwest of Abbotts Lagoon, where the taxa is found on an estimated 383 acres. This area was once part of G Ranch, but was fenced off from cattle in 1989. This occurrence has been monitored from 1983 to the present and appears to be stable. Other occurrences are located north of Abbotts Lagoon and further south, near the North Beach parking area and the Old Lifesaving Station. Three of the seven occurrences are within pastures but grazing was not considered a threat by plant monitors. Six of the occurrences are considered threatened by European beachgrass and ice plant.

A project to remove non-native species near Abbotts Lagoon will be carried out from 2001-2003. The project is focused on areas where native vegetation is still relatively intact and may provide an effective means of protecting beach layia, Tidestrom's lupine, and other native dune species from invading non-natives.

Table 20. Tidestrom's lupine Occurrences and Estimated Numbers, 2000-2002.

	2000	2001	2002
1	2,000	128,528	157,651
2	79	12	34
3	13	33	217
4	7	35	28

5	0	0	no survey
6	5,940	11,181	32,748
7	64	151	214
Total	8,103	139,940	190,892

Robust spineflower (Chorizanthe robusta va. robusta) – Endangered
In January 2002, plant taxonomists at the Jepson Herbarium confirmed that an unidentified Chorizanthe species found in Point Reyes National Seashore was the federally endangered robust spineflower (*Chorizanthe robusta var. robusta*). This is the first time that this species has been documented within Seashore lands, and the first time it had been identified within Marin County. Prior to this find, robust spineflower was known to occur only in Santa Cruz and Monterey counties, in four populations. It is most likely that this species was not identified in Point Reyes until recently because of its very similar appearance to two other species of Chorizanthe that occur within the same habitat.

Between 2002 and 2004, surveys were conducted within Point Reyes to determine the species' aerial extent, estimate the number of individuals, and to assess existing and/or potential threats to the species. Over 500 acres of potential habitat were surveyed and three robust spineflower populations were documented and mapped. In total, these populations were estimated to contain over 10,000 individuals. One population, located near Abbot's Lagoon, occurs in a very popular visitor use area. The plants occur near a parking lot, along a roadside, and in a pasture grazed by cattle. The proximity of these plants to human activities may result in threats to the long-term survival of the population. A management plan, which includes a sampling strategy, is currently being developed in order to gather accurate estimates of individual numbers within each population. Surveys of potential habitat within the Seashore continue and it is anticipated that they will result in additional population locations.

As noted in Table 15, impacts to this endangered plant are not analyzed in the Environmental Consequences section because the FMP does not treat the area where the robust spineflower is located.

Other Plant Species of Concern
Tables 21 and 22 below shows several plant species in the affected area are listed as federal "species of concern." Species of concern are species for which USFWS is collecting additional information to determine if they warrant consideration for future listing. In addition, two species (Point Reyes blennosperma and Mason's ceanothus) are considered rare by the state of California, one species is state endangered (Point Reyes meadowfoam) and all plant species in the table are on California Native Plant Society lists. In Alternative A, although no federal or state listed species have been found in FMUs that would be treated with prescribed fire, one state rare species (Mason's ceanothus) is present in the Bolinas Ridge FMU. Bolinas ceanothus does not occur in any FMUs slated for mechanical treatment in this alternative. Several federal species of concern are present in Estero and Limantour Road FMUs, which would be treated with both prescribed fire and mechanical thinning.

Although these species are not listed under the federal Endangered Species Act, NPS Management Policies (2000) state that the Service will inventory, monitor and manage state and locally listed species in a manner similar to its treatment of federally listed species, and will inventory other species that are of special management concern to parks (such as rare, declining, sensitive or unique species).

Table 21. Plant Species of Concern and California-listed Species that may Occur in Areas Affected by PRNS's Fire Management Plan (per USFWS Letter, May 24, 2001).

Common Name	Scientific Name	Known to Occur	Potentially Subject to Adverse Impacts	Comments
pink sand verbena	*Abronia umbellata ssp.breviflora*	yes	no	on coastal strand
Blasdale's bentgrass	*Agrostis blasdalei var. blasdalei*[b]	yes	yes	
Tamalpais manzanita	*Arctostaphylos hookeri ssp. Montana*	no	no	
Point Reyes stickyseed	*Blennosperma nanum var. robustum*	yes	yes	
Thurber's reedgrass	*Calamagrostis crassiglumis*[c]	yes	no	not in action FMUs
swamp harebell	*Campanula californica*	yes	yes	
Humboldt Bay owl's-clover	*Castilleja ambigua ssp. Humboldtiensis*	yes	no	in wetlands
Mt. Vision ceanothus	*Ceanothus gloriosus var. porrectus*	yes	yes	
Mason's ceanothus	*Ceanothus masonii*	yes	yes	
San Francisco Bay spineflower	*Chorizanthe cuspidata var. cuspidata*	yes	no	in stabilizing dune habitats
Mt. Tamalpais thistle	*Cirsium hydrophilum var. vaseyi*	no	no	not in action FMUs
Tomales clarkia	*Clarkia concinna ssp. raichei*	no	no	
northcoast bird's-beak	*Cordylanthus maritimus ssp. Palustris*	yes	no	in salt marsh habitat
supple daisy	*Erigeron supplex*	extirpated	no	
San Francisco wallflower	*Erysimum franciscanum*	no	no	
fragrant fritillary	*Fritillaria liliacea*	yes	yes	
San Francisco gumplant	*Grindelia hirsutula var. maritima*	yes	yes	
Tiburon tarweed	*Hemizonia multicaulis ssp. Vernalis*	no	no	not in action FMUs
Kellogg's horkelia	*Horkelia cuneata ssp. sericea*	no	no	
Point Reyes horkelia	*Horkelia marinensis*	yes	no	in grazed pastures
Tamalpais lessingia	*Lessingia micradenia var. micradenia*	no	no	
coast lily	*Lilium maritimum*	yes	no	in grazed pastures
Pt. Reyes meadowfoam (CE)[a]	*Limnanthes douglasii ssp. Sulphurea*	yes	yes	
Gairdner's yampah	*Perideridia gairdneri ssp. Gairdneri*	yes	yes	
northcoast phacelia	*Phacelia insularis var. continentis*	yes	yes	
San Francisco popcornflower	*Plagiobothrys diffusus* [d]	yes	no	not in action FMUs

northcoast semaphore grass	*Pleuropogon hooverianus*	no	no	
Marin knotweed	*Polygonum marinense*	yes	no	in salt marsh
California beaked-rush	*Rhynchospora californica*	extirpated	no	
valley sagittaria	*Sagittaria sanfordii*	no	no	
Marin checkerbloom	*Sidalcea hickmanii ssp. Viridis*	no	no	
Santa Cruz microseris	*Stebbinoseris decipiens*	no	no	
Tamalpais streptanthus	*Streptanthus batrachopus*	no	no	
San Francisco owl's-clover	*Triphysaria floribunda*	yes	yes	

a/ CE: Listed as endangered under the California Endangered Species Act
b/ Recognized by The Jepson Manual (1993) as A. densiflora
c/ Recognized by The Jepson Manual (1993) as C. stricta ssp. inexpansa
d/ Recognized by The Jepson Manual (1993) as P. reticulatus var rossianor

Table 22. Additional Plant Species of NPS Management Concern that Occur in Areas Affected by PORE's Fire Management Plan

Common Name	Scientific Name	CNPS List	Potentially Subject to Adverse Impacts	Comments
coast rock cress	*Arabis blepharophylla*	4	yes	
Marin manzanita	*Arctostaphylos virgata*	1B	yes	
coastal marsh milk-vetch	*Astragalus pycnostachyus var. pycnostachyus*	1B	no	in coastal strand habitat
coastal bluff morning-glory	*Calystegia purpurata ssp. Saxicola*	1B	yes	
Buxbaum's sedge	*Carex buxbaumii*	4	no	in wetlands
glory brush	*Ceanothus gloriosus var. exaltatus*	4	yes	
Point Reyes ceanothus	*Ceanothus gloriosus var. gloriosus*	4	yes	
unnamed ceanothus	*Ceanothus sp. nov.*	-	no	in grazed pastures
woolly-headed spineflower	*Chorizanthe cuspidata var. villosa*	1B	no	in sandy dune habitat
Franciscan thistle	*Cirsium andrewsii*	1B	yes	
western leatherwood	*Dirca occidentalis*	1B	no	not in action FMUs
California bottlebrush grass	*Elymus californicus*	4	yes	
Marin checker lily	*F. affinis var. tristulis*	1B	yes	
dune gilia	*Gilia capitata ssp. chamissonis*	1B	no	in sandy dune habitat
dark-eyed gilia	*Gilia millefoliata*	1B	no	in sandy dune habitat
white hayfield tarplant	*Hemizonia congesta ssp. Leucocephala*	3	yes	
short-leaved evax	*Hesperevax sparsiflora var. brevifolia*	2	no	in grazed grassland
perennial goldfields	*Lasthenia macrantha ssp. Macrantha*	1B	yes	
delta mudwort	*Limosella subulata*	2	no	in mud flats
large-flowered linanthus	*Linanthus grandiflorus*	4	yes	
rosy linanthus	*Linanthus rosaceus*	1B	yes	
marsh microseris	*Microseris paludosa*	1B	yes	
Point Reyes rein-orchid	*Piperia elegans ssp. decurtata*	1B	yes	

nodding semaphore grass	*Pleuropogon refractus*	4	yes	
Point Reyes checkerbloom	*Sidalcea calycosa ssp. rhizomata*	1B	no	in wet areas
beach starwort	*Stellaria littoralis*	4	yes	
Mt. Tamalpais jewelflower	*Streptanthus glandulosus ssp. Pulchellus*	1B	no	

NOTES: [1] CNPS = California Native Plant Society (Skinner and Pavlik 1994)
Listing Significance:

- List 1B: Plants Rare, Threatened, or Endangered in California and Elsewhere
- List 2: Plants Rare, Threatened, or Endangered in California, but More Common Elsewhere
- List 3: Plants About Which We Need More Information - A Review List
- List 4: Plants of Limited Distribution - A Watch List

Special-Status Wildlife

The following threatened or endangered animal species are those listed under the Endangered Species Act and considered likely or possible to experience impacts from fire management activities: Northern spotted owl (*Strix occidentalis caurina*), California red-legged frog (*Rana aurora draytonii*), Central California coho salmon (*Oncorhynchus kisutch*), Central California Coast steelhead (*Oncorhynchus mykiss*), California freshwater shrimp (*Syncaris pacifica*), Myrtle’s silverspot butterfly (*Speyeria zerene myrtleae*), Western snowy plover (*Charadrius alexandrinus nivosus*). All listed, proposed, or candidate animal species in the study area are listed in Table 24. A section on animal species not listed under the Endangered Species Act, but of concern to federal or state agencies follows.

Federally listed animal species

Northern Spotted Owl (*Strix occidentalis caurina*) - Threatened

Habitat within the project area supports one of the densest populations of Northern spotted owl in the world. In Marin County, the owls live in second growth Douglas-fir (*Pseudotsuga menziesii*), Bishop pine (*Pinus muricata*), coast redwood (*Sequoia sempervirens*), mixed conifer-hardwood and evergreen hardwood forests as well as remnant old-growth stands of coast redwood and Douglas-fir. The habitat types for the Northern spotted owl are defined as multi-layered, multi-species with >60% total canopy cover for nesting/roosting with large overstory trees, large amounts of down woody debris, presence of trees with defects or signs of decadence in the stand. Small isolated pieces of habitat are not regarded as suitable. Northern spotted owls are residents throughout PRNS and GGNRA and occur in habitat types that are atypical when compared to other areas of the species range. For example, owls have been observed nesting in young bay (*Umbellularia californica*) trees in small stands. Nevertheless, most nesting and roosting sites do occur in older, decadent stands of conifer and hardwood trees with large overstory trees. Preliminary pellet analyses indicate that spotted owls in Marin forage primarily on dusky-footed woodrats (*Neotoma fuscipes*) as well as other small mammals and forest-dwelling birds (Chow and Allen, 1998). The Northern spotted owl is found in the Inverness Ridge FMU, eastern Limantour FMU, North and South Wilderness FMUs, Highway One and Bolinas FMUs.

The Northern spotted owl (*Strix occidentalis caurina*) was federally listed as threatened in 1992 (USFWS 1993). A ¼ mile radius buffer zone must be protected around active nest sites to protect the birds from the impacts of noise and smoke. A severe wildfire may alter the owl's habitat, making it unsuitable for the species. The degree of habitat modification that can occur within a given radius of an owl activity site is regulated by the California Code of Regulations, Title 14, §919.9(g)(1) addressing Wildlife Protection Practices for the Northern Spotted Owl.

The parks contain approximately 35,000 acres of potential northern spotted owl habitat. Extensive surveys of habitat use, distribution and abundance have been conducted since 1993 by the NPS and these surveys will continue. A recent census estimated a population of approximately 49 owl activity centers (Chow and Allen, 1996, Chow and Allen, 1998, Fehring and Adams, 2001, NPS, 2002b). The parks initiated a demographic study of owls in 1998 and have been banding owls annually under permit from the USFWS (Permit # 842449). The overall population trend is unknown, but we believe the population is stable because the number of activity centers has been similar among years since 1998 when an inventory was completed of the park. Table 23 describes each of the occupied site's history to date.

While conducting an inventory of owls within the parks following USFWS protocols, biologists noted the habituation of owls to people, resulting in owls approaching people in campgrounds. Consequently, the parks developed a modified protocol from the USFWS protocol to reduce interactions with owls during surveys. The modified protocol was developed in collaboration with USFWS, and resulted in a reduction in the use of mice to confirm owl presence and productivity.

No critical habitat for the spotted owl has been designated within PRNS or the Northern District of GGNRA, although much of the parks contain high quality owl habitat. Critical habitat was not designated because the park habitat is protected from adverse effects due to its National Park status. The park is in the process of analyzing habitat associations of occupied sites and nest site descriptions. The Point Reyes Bird Observatory, in collaboration with the NPS, will have a final report completed on this analysis in 2003.

Table 23. Site History of Northern Spotted Owl Activity Centers within PRNS and the Northern District of GGNRA

Marin County Spotted Owl Activity Site Number	Landowner	Survey Purpose	Survey Years
MR001	TBSP	Demography	1997-2001
MR002	TBSP	Demography	1997-2002
MR003	PVT	Inv/Mgmt	1997-1998, 2002
MR004	PRNS	Demography	1997-2002
MR005	PRNS	Demography	1997-2002
MR006	PRNS	Inv/Mgmt	1997-1998,2001-2002
MR007	PRNS	Demography	1997-2002
MR008	PRNS	Inv/Mgmt	1998, 2002
MR012	PVT	Demography	1997-2002
MR018	PRNS	Demography	1997-2002
MR021	PVT	Inv/Mgmt	1997-1998, 2001-2002
MR022	PRNS	Demography	1997-2002
MR023	PRNS	Inv/Mgmt	1998, 2002
MR024	PRNS	Inventory	1997-1998
MR026	PVT	Inventory	1997-1998

MR027	TBSP	Demography	1997-2002
MR028	PVT	Inv/Mgmt	1997-1998, 2002
MR029	PVT	Demography	1997-2002
MR030	PRNS	Demography	1997-2002
MR031	PVT	Demography	1997-2002
MR032	PVT	Inventory	1997-1998
MR033	PVT	Inventory	1997-1998
MR034	GGNRA	Demography	1997-2002
MR035	GGNRA	Demography	1997-2002
MR039	GGNRA	Demography	1997-2002
MR040	GGNRA	Demography	1997-2002
MR041	GGNRA	Demography	1997-2002
MR046	PVT	Demography	1997-2002
MR047	TBSP	Demography	1997-2002
MR048	TBSP	Inventory	1997-1998
MR049	PRNS	Demography	1997-2002
MR050	PRNS	Demography	1997-2002
MR051	PRNS	Demography	1997-2002
MR052	PRNS	Demography	1998-2002
MR053	PVT	Inventory	1997-1998
MR054	GGNRA	Demography	1997-2002
MR056	TBSP	Inv/Mgmt	1997-1998, 2001-2002
MR057	PRNS	Demography	1997-2002
MR058	GGNRA	Demography	1997-2002
MR059	PRNS	Demography	1997-2002
MR063	PVT	Inv/Mgmt	1998, 2002
MR064	GGNRA	Demography	1998-2002
MR067	PVT	Demography	1998-2002
MR068	GGNRA	Demography	1998-2002
MR069	GGNRA	Demography	1997-2002
MR070	PRNS	Inventory	1997
MR072	GGNRA	Demography	1998-2002

TBSP (Tomales Bay State Park), PVT (Private land adjacent to Seashore boundaries). Source: Marin County Spotted Owl Database, PRNS, CA.

Thirty-two sites in PRNS and North District GGNRA are included in a long-term demographic study. Other sites were included in an inventory of all spotted owl habitat on federal lands conducted in 1997 and 1998. A subset of these sites were monitored in 2001 and 2002 because of their proximity to Wildland-Urban Interface Hazardous Fuel Reduction Projects at PRNS.

Red-legged Frog (*Rana aurora draytonii*) – Threatened

PRNS and GGNRA support one of the largest known populations of California red-legged frogs. This frog frequents marshes, slow parts of streams, lakes, stock ponds, and other usually permanent waters. The frog is generally found near water but disperses during rain events and after breeding season to non-breeding habitat adjacent to water bodies. The non-breeding habitat is usually a moist area with some cover such as a willow or blackberry thicket.

The U.S. Geological Survey Biological Resources Division (USGS-BRD) has conducted surveys of aquatic habitats in PRNS and GGNRA since 1993 under the direction of Dr. Gary Fellers.

Survey protocol is adapted from USFWS practices and has been published as a NPS Technical Report (Fellers & Freel, 1995).

Surveys have been conducted on virtually all sites containing aquatic habitat that could support amphibians. Field data includes information on habitat type (permanent or seasonal, natural or created), water characteristics, (depth, flow, turbidity, etc.), vegetation (emergent, floating, and surrounding the site), disturbance, including current grazing, and the age classes and physical condition of amphibians found.

Field surveys have led to documentation of numerous sites used by the California red-legged frog; sites have been mapped in a geographically related database. Approximately 76 sites are located on ranch lands, with a large proportion located at stock ponds. A breakdown of sightings according to the type of habitat use observed (breeding vs. non-breeding, upland dispersal vs. other upland habitat use, etc.) has yet not been made, since survey work is ongoing and it is believed that new locations will be detected. It is likely that further surveys will document additional red-legged frog sites at PRNS/GGNRA. Several new breeding sites have recently been found along tributaries of Olema Creek. Several large bodies of water, such as Abbott's Lagoon, are expected to yield new sites during a planned boat survey, which will allow more thorough coverage than has been attained by foot surveys. In FY04, PRNS plans to survey the wilderness area of the park to determine additional breeding and non-breeding habitat.

Table 24. Federal Threatened, Endangered, Candidate, and Proposed Animal Species that May Occur in Areas Affected by PRNS's Fire Management Plan (per Attachment A in USFWS Letter, May 24, 2001).

Common Name	Scientific Name	Listing Status[a]	Known to Occur	Potentially Subject to Adverse Impacts[b]
Mammals				
blue whale	*Balaenoptera musculus*	E	rare	No[b]
finback (=fin) whale	*Balaenoptera physalus*	E	rare	No[b]
gray whale	*Eschrictus robustus*	D	yes	No[b]
Guadalupe fur seal	*Arctocephalus townsendi*	T	yes	No[b]
humpback whale	*Megaptera novaeangliae*	E	yes	No[b]
right whale	*Eubalaena glacialis*	E	no	No
sei whale	*Balaenoptera borealis*	E	no	No
sperm whale	*Physeter catodon (macrocephalus)*	E	yes	No[b]
Steller (=northern) sea-lion	*Eumetopias jubatus*	T	yes	No[c]
Birds				
Aleutian Canada goose	*Branta canadensis*	E	rare	No[b]
American peregrine falcon	*Falco peregrinus anatum*	D	yes	No
bald eagle	*Haliaeetus leucocephalus*	T	rare	No
California brown pelican	*Pelecanus occidentalis californicus*	E	yes	No
California clapper rail	*Rallus longirostris obsoletus*	E	yes	No
greater sandhill crane	*Grus canadensis tubida*	T	rare	No
marbled murrelet	*Brachyramphus marmoratus*	T	yes	No
northern spotted owl	*Strix occidentalis caurina*	T	yes	Yes
short-tailed albatross	*Diomedea albatrus*	PE	rare	No[b]
western snowy plover	*Charadrius alexandrinus nivosus*	T	yes	No
Reptiles				
green turtle	*Chelonia mydas (incl. agassizi)*	T	rare	No[c]
leatherback turtle	*Dermochelys coriacea*	E	yes	No[c]
loggerhead turtle	*Caretta caretta*	T	rare	No[c]
olive (=Pacific) ridley sea turtle	*Lepidochelys olivacea*	T	rare	No[c]
Amphibians				
California red-legged frog	*Rana aurora draytonii*	T	yes	Yes
California tiger salamander	*Ambystoma californiense*	C	no	No
Fish				
central California coho salmon	*Oncorhynchus kisutch*	T	yes	Yes
central California coast steelhead	*Oncorhynchus mykiss*	T	yes	Yes
delta smelt	*Hypomesus transpacificus*	T	unknown	No
Sacramento splittail	*Pogonichthys macrolepidotus*	T	unknown	No

So. OR/CA coastal chinook salmon	*Oncorhynchus tshawytscha*	T	no	No
threespine stickleback	*Gasterosteus aculeatus williamsonii*	E	no	No
tidewater goby	*Eucyclogobius newberryi*	E	no	No
Invertebrates				
black abalone	*Haliotes cracherodii*	C	yes	No[b]
California freshwater shrimp	*Syncaris pacifica*	E	yes	Yes
Myrtle's silverspot butterfly	*Speyeria zerene myrtleae*	E	yes	Yes
white abalone	*Haliotes sorenseni*	PE	no	No

a. Listing status: E: Endangered T: Threatened C: Candidate PE: Proposed Endangered D: Delisted
b. Offshore marine species (e.g., whales, pelagic birds) are expected to receive little to no impact from fire management activities. Fire management activities such as prescribed fires and mechanical treatments are not planned to occur adjacent to coastal bluffs, beaches, or dunes and smoke will be directed away from any marine mammal sites. Unplanned wildfire and associated suppression activities could occur in these areas and very minor impacts could occur if wildland fire reduces vegetation cover near coastal bluffs, and sediments are removed from the bluffs and deposited in coastal waters. These sediments would be quickly diluted when they reach the ocean, and impacts to marine species are expected to be insignificant.
c. Species that use beaches as haulouts may be disrupted by unplanned wildfire and the associated suppression activities. Impacts could be caused by smoke or by sedimentation as mentioned in the previous paragraph. Among Threatened and Endangered species, however, such habitat use is restricted to marine turtles, which are unlikely to occur at PRNS. Steller's sea-lions are more likely to use rocky shorelines as haulouts.

Creation of stock ponds and other small impoundments on ranches over the past 100 years has likely resulted in increased numbers and an expansion in range for red-legged frogs in the PRNS area (G. Fellers, pers. comm.). Frogs appear to move readily between these ponds during periods when the ground is moist, which is prolonged on the foggy PRNS peninsula. Numerous wet swales, seasonal springs, and ephemeral pools provide dispersed travel and feeding habitats. In GGNRA, riparian habitat along creeks provides corridors for travel along the Olema Valley and its tributaries.

PRNS, GGNRA, and adjoining areas of Marin County comprise one of the 57 core areas for focused recovery of red-legged frogs established in the Final Recovery Plan for the species. Much of the project area falls within the recently established criteria for red-legged frog critical habitat. The central peninsula has roughly 75 stock ponds in an area extending from the Kehoe Ranch near Pierce Point south to Point Reyes itself and east to Tomales Bay, Mt. Vision, and the Laguna Ranch (now the Clem Miller Environmental Education Center). Approximately 50 of these ponds are located on land currently used for ranching, with most of the remaining 25 on former ranch lands on Inverness Ridge and above Limantour Estero. Most of these ponds retain water at least 20" deep well into the summer, and a number are perennial in typical rainfall years. Evidence of breeding red-legged frogs has been observed in many of these ponds. Pond habitat and several perennial creeks are densely clustered on the Point. Distances of under 1.25 miles separate one or more adjacent aquatic habitats, and the ground between them is suitable for red-legged frog overland movement. Traffic along Sir Francis Drake Boulevard, the only major potential barrier to movement, is less than 30 cars per hour on late fall and winter nights, when adult red-legged frogs are most likely to be traveling overland. The habitat area for red-legged frogs on central Point Reyes encompasses all of the grazing land there.

A second interconnected habitat area extends along the Olema Valley, where the perennial segment of Olema Creek links scattered off-stream aquatic habitats from the vicinity of Point Reyes Station south approximately 13.5 km. Stock ponds are less common in the Olema Valley than on the peninsula, numbering less than 20. Red-legged frogs have been observed in most of the tributaries on the eastern side of Olema Creek, where ranching occurs.

Suitable habitat along Olema Creek and its tributaries may have been adversely affected by geomorphologic instability associated with historic logging of parts of Inverness Ridge, channel alterations in the lower 2.8 km of Olema Creek, and the effects of highway culverting. Areas of downcutting, bank cutting, and sedimentation are present along the mainstem and its tributaries, resulting in a probable reduction in numbers of backwaters and pools.

Red-legged frogs have also been found on Bolinas Mesa and at several ponds on top of Bolinas Ridge. Since frogs could be present in unsurveyed locations on Inverness Ridge, and could travel along seasonally wet riparian corridors over the ridge, all the red-legged frog sighting locations have been linked into one metapopulation.

Potential impacts of projects on red-legged frog aquatic habitats is summarized in Table 25, which is based on pages 31-34 of the Draft Recovery Plan.

Table 25. Potential Impacts on Red-legged Frog Aquatic Habitats

Impact	Potential Effect on CRLF Habitat
Emergent vegetation removed	Emergent vegetation necessary for amplexus and anchoring egg masses. Excessive levels may reduce sunlight needed for growth of algae, which is chief larvae food.
Shading vegetation removed (emergent and bank side)	Chiefly harmful to adults, for whom shaded refugia may be critical in drier inland areas during the summer.
Insect habitat vegetation removal	Harmful to adults and juveniles that mainly feed on invertebrates for which bank side vegetation is prime habitat.
Excess water drawdown in ponds	Leave egg masses stranded on vegetation
Change hydrological regime by accelerating runoff	Pools may dry before metamorphosis completed

Riparian Areas

Based on survey data, the most important riparian areas for red-legged frogs in PRNS/GGNRA are those with relatively low gradient that have late season water flow or water retention in pools. On Point Reyes itself, such creeks support relatively few of the documented occurrences of the frogs, but they may serve as connector and refuge habitats. The most important of these are Kehoe Creek and Abbotts Lagoon Creek on the north end of the peninsula, and Schooner Creek, which drains into Drakes Estero.

In GGNRA and PRNS, Olema Creek is the most significant habitat for red-legged frogs. Approximately one-third of its length is outside of the ranching zone, while the remainder is fenced off from direct access by cattle along its entire length. The character of Olema Creek changes near the town of Olema, where it develops a substantial floodplain that extends to Sir

Francis Drake Blvd., just before the confluence with Lagunitas Creek. Several slough-like channels occur in the floodplain, fed either by Olema Creek or several tributaries that empty onto it. Since the mid 1990s, Olema Creek has recaptured its historic floodplain, to the north of the Olema Ranch Campground. This 9 acre floodplain is permanently excluded from livestock access and supports a diverse recovering riparian floodplain and willow flat. While these sloughs appear to be suitable as breeding habitat for red-legged frogs, there are no records from this area. Egg masses may be washed out by high flows or juveniles eaten by herons and other predators.

A Biological Opinion regarding agricultural operations within the Seashore, completed by the USFWS in 2002, addresses all issues related to ongoing ranch operations within lands known to support the California red-legged frogs.

Stock Ponds

Red-legged frogs have been detected in over 40 of the stock ponds scattered over PRNS and another 10 in GGNRA. Many of the ponds have minimal shading vegetation, although this may be a characteristic of the pond site rather than cattle presence. This is especially true on the Point, where trees are relatively sparse in the grassland and dune areas. Emergent vegetation also varies by pond, but overall is considered to be enough for red-legged frog reproduction but not excessive, which would reduce open water needed by larvae and the algal growth they feed on (G. Fellers, pers. comm.).

Observations on vegetation surrounding ponds, and on percent cover of pond surfaces by emergent and floating vegetation is part of the data collected in amphibian survey work. The extent to which presence of such vegetation beyond minimal levels is important to red-legged frog reproduction is not clear. In an effort to identify the optimal level of emergent and submerged vegetation for red-legged frogs, biologists at the East Bay Regional Park District used data from 265 ponds located in their parks, which together support an estimated 500-600 breeding adult frogs. Presence of frogs was compared at ponds with three levels of vegetation cover: no cover, cover less than 15%, and cover more than 15%. No significant differences in the presence of red-legged frog larvae, juveniles, and adults were found (S. Bobzien, pers. comm.).

Central California Coast Coho Salmon (*Oncorhynchus kisutch*) – Threatened and Central California Steelhead (*Oncorhynchus mykiss*) - Threatened

Central California coast coho salmon and Central California steelhead (hereafter referred to as coho and steelhead) occur in several creeks on the Point Reyes peninsula and in the Lagunitas Creek watershed that drains portions of PRNS and GGNRA. Coho salmon and steelhead trout are found in the Olema, Lagunitas and Pine Gulch Creek watersheds. Steelhead trout are also found in the Tomales Bay, Drakes Estero, and Bolinas watersheds.

Designated critical habitat for coho in PRNS includes all accessible estuarine and stream areas in the coastal watersheds of Marin County except areas above longstanding, naturally impassable barriers or above Peters Dam on the mainstem of Lagunitas Creek and Seeger Dam on Nicasio Creek (NOAA Fisheries, 1996). Although critical habitat has not been established for central California steelhead, it is likely to be the same as that for coho in Marin County.

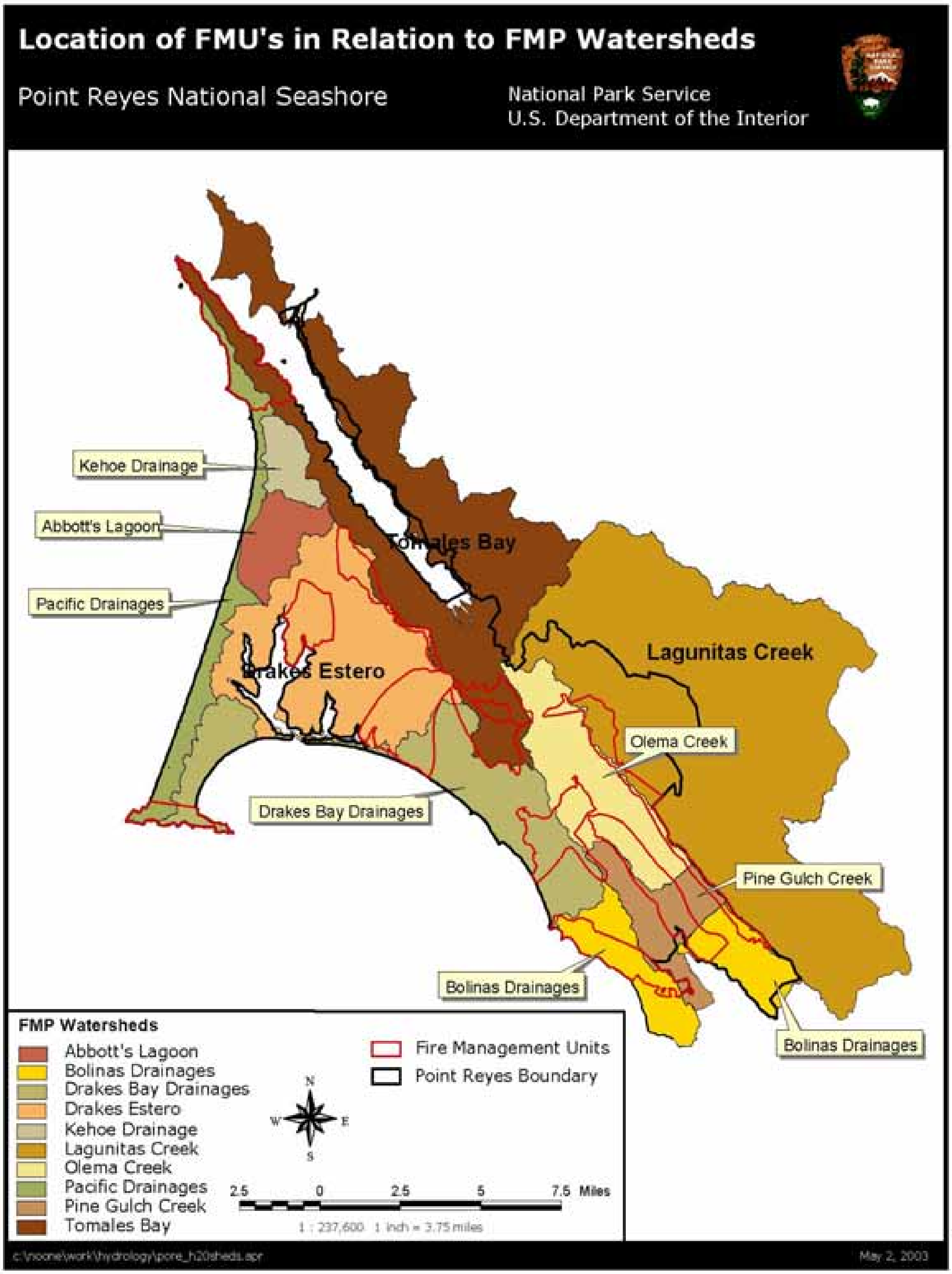
Dating back to the late 1800s, West Marin County was a popular destination for salmon fishing. Records of salmon hatchery releases to Lagunitas Creek and even Bear Valley Creek occurred even in the 1890s. Lagunitas Creek (then known as Papermill Creek) still holds the distinction as having produced the state record, 22 pound, coho salmon (caught by Milton T. Hain, January 3, 1959). Interviews with long time residents and fisheries managers suggest that coho and steelhead in the project area have been declining since the turn of the century, with significant declines occurring as late as the mid-1950's. Most historic information on salmonid numbers is anecdotal, while quantified data are lacking. Accounts by local residents of "excellent trout fishing" along Lagunitas and Olema creeks may refer to young steelhead, which are indistinguishable from rainbow trout during the three year period they typically spend in fresh water. Similarly, early accounts of "salmon runs" may refer to both coho and steelhead, which may not have been distinguished by fishermen. Such anecdotal information suggests that salmonids were abundant in the Lagunitas/Olema Creek drainage before extensive alteration by dam-construction, logging, and channelization. On its 1996 federal listing, the Lagunitas watershed, including Olema Creek, was documented to support 10% of the Central California Coast coho population (Brown et al., 1994, NOAA Fisheries, 1996).

NOAA Fisheries designated critical habitat for coho salmon to include all accessible reaches of rivers (including estuarine areas and their tributaries) (NOAA Fisheries, 1999). Through this designation, NOAA Fisheries identified ten essential features of critical habitat including: substrate, water quality, water quantity, water temperature, water velocity, cover/shelter, food, riparian vegetation, space, and safe passage conditions.

The Magnuson-Stevens Fishery Conservation and Management Act, as amended by the Sustainable Fisheries Act of 1996 (PL 104-267), established new requirements for Essential Fish Habitat (EFH). Coho salmon and Chinook salmon are managed under Federal Fishery Management Plans, steelhead are not. Therefore, EFH conservation recommendations address only coho salmon, and not steelhead trout. Watersheds supporting coho salmon associated with the project are also protected under EFH regulations.

Reliable quantitative survey data for coho salmon dates from 1948, when the California Department of Fish and Game (CDFG) began annual surveys of coho numbers and spawning activity on Devil's Gulch, a tributary of Lagunitas Creek. Survey work on the Lagunitas mainstem began in the winter of 1982-83 by consultants to the MMWD. Beginning in the mid 1980s, biologists began collecting juvenile information and some smolt trapping was conducted on Lagunitas Creek.

Figure 16. Location of FMUs in Relation to FMP Watersheds



Historic and current data on coho and steelhead populations for Lagunitas, Olema, and Pine Gulch Creek watersheds have been gathered as part of the Coho salmon and Steelhead trout Restoration Program (CSRP) and the Marin Municipal Water District. Through the CSRP, the NPS has established a detailed fisheries monitoring program that is carried on through support from the Natural Resource Challenge Inventory and Monitoring Program, as well as monitoring support through California Department of Fish and Game managed grant programs.

For most drainages, monitoring has focused on coho salmon, but includes equivalent information for steelhead trout. Differences between steelhead trout and coho salmon life cycles are pertinent to conservation efforts. While virtually all coho in project area watersheds have an 18 month freshwater life cycle, steelhead juveniles may migrate to the ocean after 18 months or extend freshwater residence for up to three years. Most coho return to spawn after 18 months, but steelhead may spend several years in the ocean before returning to spawn. Additionally, steelhead may make several spawning migrations while all coho spawn once and die. The variable life cycle of steelhead makes population analysis more difficult, but also makes them more resilient to adverse environmental conditions. In general, if the habitat requirements for coho are met, steelhead habitat requirements will also be met.

Estimates for adult coho escapement (numbers of spawning coho), were derived using the Peak Live plus accumulated Dead (PLD) index method, in which the highest count of living fish found in a single survey is added to the cumulative number of dead fish counted up to that time. The PLD index provides a minimum count of spawning fish in a season, based upon actual field observation. While the PLD index is best when peak numbers are counted, visibility and flow conditions are highly variable and can affect the quality of a field survey. The PLD is interpreted as an indication of spawning success, along with other monitoring parameters including redd counts, summer juvenile densities, and smolt outmigration, it can be used to as an indicator of population condition.

In conjunction with adult escapement surveys, the NPS staff and volunteers document redds, or egg nests. Because redds are often visible long after fish have spawned, and they can be marked to avoid double counting, it has been used in the watershed as an indices of the spawning run. However, since coho and steelhead may construct false redds, and redds may be washed over or difficult to distinguish, these data are best used to indicate spawning activity between years and watersheds. In the last five years, adult escapement monitoring efforts by the MMWD, PRNS, and other local organizations have included detailed redd counts.

Review of historical spawner abundance data supports anecdotal evidence of declining numbers of coho over the last 50 years. This corresponds to a similar trend region-wide. Since the mid-1990s, current monitoring effort shows that populations of both coho salmon and steelhead trout, while fluctuating, within the project area, remain persistent, and are considered stable.

Fisheries information are summarized by watershed areas as described in the Water Resources section.

<u>Tomales Bay Watershed.</u> The Tomales Bay watershed includes all of the small watersheds draining from Inverness Ridge and Bolinas Ridge directly to the Bay. The largest of these

watersheds, Bear Valley Creek is included within the Limantour Road FMU. In addition, the watershed includes small portions of the Tomales Point, Wilderness North, and Inverness Ridge FMUs. The watersheds within the each of these FMUs, with the exception of Tomales Point, support habitat for steelhead trout. No quantitative fisheries monitoring beyond presence/absence surveys have been conducted in these systems.

Lagunitas Creek Watershed. Lagunitas Creek and its tributaries (Nicasio Creek, San Geronimo Creek, Devil's Gulch, Cheda Creek, Bear Valley Creek, and Olema Creek) drain more than 230 square kilometers of western Marin County. The headwaters of the Lagunitas Creek mainstem lie within the 53,000 ha watershed lands administered by MMWD. The mainstem originally totaled about 40 km of perennial stream draining the northern slope of Mt. Tamalpais, but was reduced by more than 50% by construction of Alpine Dam in 1918 and Peters Dam in 1953. Because neither dam has provision for fish passage, their construction resulted in permanent loss of the upper portion of the drainage to anadromous fish.

The portions of the Lagunitas drainage most significant for salmonids are under a number of ownerships. Approximately 12 km of the mainstem is bordered by lands within GGNRA. A major tributary, San Geronimo Creek, flows through privately held land in San Geronimo Valley. Devil's Gulch lies almost entirely within Samuel P. Taylor State Park with its headwaters in GGNRA. Only one smaller tributary of Lagunitas Creek, Cheda Creek, lies entirely within GGNRA lands. Within the Lagunitas Creek watershed, the Bolinas Ridge FMU is the only active unit.

Lagunitas Creek has long supported populations of coho salmon and steelhead trout. Recent monitoring efforts within Lagunitas Creek have identified the presence of Chinook salmon for the past four years (MMWD, 2003) with less frequent occurrences of chum and even pink salmon.

Coho numbers for the Lagunitas watershed taken as a whole based on surveys of 36 km of the mainstem and its tributaries, including Olema Creek, Devil's Gulch, and San Geronimo Creek, are shown in Table 26. Surveys were conducted during three periods between 1982-2003. Surveys differed in coverage and data gathered, but show an increasing trend in number of redds located. Total numbers of spawning coho using the drainage are suggested by PLD Index value high counts of 525 fish in 1996/97.

Table 26. Coho Salmon Spawning Survey Data for Overall Lagunitas Creek Watershed

Year	Number of Surveys	Survey Area (km)	PL Index[c]	Total Carcasses	Total New Redds	Source
1982/83[a]	6	22.4	n.a.	n.a.	139	Bratovich & Kelly 1988
1983/84[a]	6	22.4	n.a.	n.a.	44	Bratovich & Kelly 1988
1991/92[a]	1	20.0	n.a.	n.a.	41	Wise 1992
1995/96[b]	10	36	290	n.a.	86	Trihey & Assoc. 1996
1996/97[b]	8	36	525	92	254	Trihey & Assoc. 1997
1997/98[b]	10	36	241	112	360	MMWD, PRNS
1998/99[b]	10	36	147[d]	34	227	MMWD, PRNS
1999/00[b]	14	36	496[d]	65	220	MMWD, PRNS
2000/01[b]	14	36	380[d]	130	338	MMWD, PRNS

2001/02[b]	15	36	463[d]	146	375	MMWD, PRNS
2002/03[b]	13	36	463[d]	60	175	MMWD, PRNS

a/ Does not include Olema Creek and its tributaries.
b/ Includes Olema Creek and its tributaries.
c/ PLD Index = Peak Live and Cumulative Dead Index; n.a. = not available.
d/ Mainstem Lagunitas estimate based on total live coho observations and may include repeat sightings of same fish
MMWD = Marin Municipal Water District data; PRNS = Point Reyes National Seashore data

As discussed earlier, PL index data have not been consistently gathered for all creeks in the project area and can vary in quality depending on the number of surveys conducted and other factors. Data on the number of new redds provides a good overview of recent spawning activity in PRNS watersheds (Table 27). These data indicate the high annual variability in coho spawning activity and the relative importance of Olema Creek to spawning in the Lagunitas Creek drainage.

Table 27. Total Coho Redds in Lagunitas Creek Watershed, 1995-2003 (MMWD & PRNS)

Year	Lagunitas Creek mainstem	San Geronimo Creek (mainstem+tribs)	Devil's Gulch (+ Cheda)	Olema Creek (mainstem+tribs)	Total new redds
1995/96	70	6	10	n.a.	86
1996/97	98	115	42	n.a.	255
1997/98	80	107 + 14	46	126 + 7	380
1998/99	92	46 + 14	31	42 + 1	226
1999/00	139	58 + 3	3	10 + 7	220
2000/01	119	56 + 18	11	86 + 48	338
2001/02	79	102 + 43	59 + 3	58 + 31	375
2002/03	71	39 + 22	24 + 2	5 + 12	175

n.a. = not available.

The contribution of the Lagunitas Creek mainstem to overall spawning activity in that drainage is indicated by data collected by MMWD since 1982 (Table 27). Coho spawner counts and redd data show that much spawning activity takes place on Lagunitas Creek tributaries. Spawning on the mainstem takes place largely in Samuel P. Taylor State Park, upstream of PRNS-administered grazing lands.

Table 28. Coho Salmon Spawning Survey Data for Lagunitas Creek Mainstem

Year	Number of Surveys	PDL Index	Total Carcasses	Total New Redds	Source
1982/83	6	n.a	n.a	65	Bratovich & Kelly 1988
1983/84	6	n.a.	n.a.	26	Bratovich & Kelly 1988
1991/92	1	n.a.	n.a.	34	Wise 1992
1995/96	10	129[a]	n.a.	70	Trihey & Assoc. 1996
1996/97	8	170[a]	23	98	Trihey & Assoc. 1997
1997/98	10	46	27	80	MMWD
1998/99	8	56[b]	6	92	MMWD
1999/00	14	371[b]	37	139	MMWD
2000/01	14	181[b]	18	119	MMWD
2001/02	15	214[b]	25	79	MMWD
2002/03	13	283[b]	18	71	MMWD

a/ Peak live fish counts only, no cumulative dead.
b/ Total live fish observations, may include repeat sightings of same fish
n.a. = not available.
MMWD = Marin Municipal Water District data

The mouth of Lagunitas Creek and adjacent floodplain supports activities associated with the Waldo Giacomini dairy. This 563-acre property, once tidal wetlands, was diked and drained in the early 1940s to create pastures. For many years, a gravel dam was constructed annually just below the confluence of Lagunitas and Olema creeks for irrigation and stock watering. The dam created an abrupt transition from fresh to saline water for smolts and spawning adults, eliminating the transition zone found in an unimpaired estuarine system. The transition zone allows smolting fish time to adjust to saline conditions and provides productive feeding zones where both freshwater and saltwater invertebrates are available.

The dam and the levees concentrated the area where spawning fish could hold and smolts could feed, and increased the potential for predation. While the annual construction of the dam has been discontinued, the levees are still in place. PRNS is currently acquiring these lands and developing a floodplain restoration plan. A phased restoration project requiring from five to ten years is planned to begin after final acquisition in 2007. Such restoration is expected to improve estuarine smolt and adult emigration habitat for both coho and steelhead.

Devil's Gulch has the longest period of spawner survey records for the Lagunitas Creek watershed. CDFG biologist Eric Gerstung and warden Al Giddings noted live coho and steelhead observations from 1948 to 1977. Consultants for MMWD conducted surveys from 1982-84 and 1995-97. PRNS expanded the sampling area further upstream in 1996-97 (Table 29). Prior to 1982/83, no more than two surveys were conducted in a single season and carcasses and redd data were not consistently collected. During a single survey in 1948, 174 coho and steelhead were counted in a 2.6 km reach. Between 1957/58 and 1976/77, peak counts of live coho ranged between 70 and 130 fish. Coho numbers had dropped by the 1990s, with PL index values between 1995/96 and 2002/03 ranging from 10 to 78 fish.

Table 29. Coho Salmon Spawning Survey Data for Devil's Gulch

Year	Number of Surveys	Survey Area (km)	PDL Index	Total Carcasses	Total New Redds	Source
1948	1	2.6	174[a]	n.a.	n.a.	Gerstung & Giddings
1957/58	2	2.4	100[b]	n.a.	74	Gerstung & Giddings
1960/61	1	2.6	77[b]	n.a.	n.a.	Gerstung & Giddings
1961/62	1	2.6	70[b]	n.a.	n.a.	Gerstung & Giddings
1964/65	1	1.6	91	76	n.a.	Gerstung & Giddings
1965/66	2	2.6	130[b]	n.a.	n.a.	Gerstung & Giddings
1976/77	1	2.4	100	90	n.a.	Gerstung & Giddings
1982/83	6	2.4	n.a.	n.a.	23	Bratovich & Kelly 1988
1983/84	6	2.4	n.a.	n.a.	11	Bratovich & Kelly 1988
1995/96	6	2.4	19[b]	n.a.	10	Trihey & Assoc. 1996
1996/97	3	3.2	47	20	42	Trihey & Assoc. 1997; PRNS
1997/98	8	3.2	27	9	46	PRNS
1998/99	6	3.2	26	6	31	PRNS
1999/00	2	3.2	10	1	3	PRNS
2000/01	4	3.2	14	2	11	MMWD
2001/02	11	3.2	46	12	59	MMWD
2002/03	5	3.6	78	1	24	MMWD

a/ Peak live fish count includes both coho and steelhead, does not include carcass data.
b/ Peak live fish counts without accumulated carcass data.
n.a. = not available.
MMWD = Marin Municipal Water District data; PRNS = Point Reyes National Seashore data

Cheda Creek, a Lagunitas Creek tributary, has been surveyed since 1996/97 by PRNS to detect the presence or absence of coho. Surveys were during peak migrations of coho in nearby drainages, when passage and attraction flows were sufficient and water clarity was not limiting. Coho presence in this creek appears to be sporadic, with no spawning activity detected during the winters of 98/99 and 00/01. However, coho spawning may be increasing, with four live fish and three redds seen in '01/02 and two fish and two redds in 02/03.

Until recently, much of the creek's potential spawning area was blocked by a failed sediment control structure. Construction of a fish passage structure consisting of a series of stepped pools was completed in 2000. Fencing to exclude cattle from 2.5 km of the creek above and below this structure has been completed. During fall, 2000, juvenile coho were observed in the project area. In anticipation of future spawning activity resulting from greater access to suitable habitat, monitoring of coho and steelhead juveniles on Cheda Creek will continue to be implemented.

<u>Olema Creek Watershed.</u> Olema Creek flows through the rift valley created by the San Andreas fault and joins Lagunitas Creek within the estuarine area, roughly three kilometers south of Tomales Bay. It is the largest drainage within the PRNS administrative area, providing the greatest habitat area and diversity. Most of Olema Creek's watershed is contained within the boundaries of GGNRA and PRNS, with only small pockets of private lands concentrated around the town of Olema. The Vedanta Society owns and manages 2,143 acres on the west side of the stream, but the land-use intensity on most of the property is very low.

The 37 km^2 Olema Creek watershed consists of a linear drainage basin that is approximately 14.5 km long and 3.2 km across at its widest point. The creek consists of 17.4 km of stream channel, which has several distinct sections. From its mouth to 11.9 km, it has continuous perennial flow, while above this section the creek becomes a series of isolated pools during the summer. Above 15.0 km, the creek usually dries up entirely in the summer. Numerous short tributaries enter Olema Creek from the east and west.

Olema Creek crosses the San Andreas Fault near Five Brooks, and again about 1 km downstream. At this location there are substantial natural landslides occurring on both sides of the creek. The west side of the drainage is largely covered by Douglas-fir forest. Extensive logging in this area prior to 1964 resulted in further instability of the channel. The hydrology of Olema Creek also has been altered by the straightening of the lower 3 km of its channel in the 1920s, and by construction of levees on Lagunitas Creek below the confluence with Olema Creek. Channel instability caused by these factors continues to cause bank cutting and failure, which is dramatic in several locations. The east side of Olema Valley consists of deep canyons dissecting the extensive grasslands of Bolinas Ridge. These grasslands have been grazed by cattle for 150 years.

Like Lagunitas Creek, Olema and its tributaries support both coho salmon and steelhead trout. Three FMUs, Bolinas Ridge, Highway One, and Wilderness South include portions of the Olema Creek watershed. These FMUs encompass 28% of the total watershed area (see Table 11).

The perennial section of Olema Creek has been systematically surveyed for live adult coho, carcasses, and redds since the winter of 1994/95 (Table 30). Results have shown considerable variability from year to year. As in other creeks in the Lagunitas drainage, Olema Creek had a high count for coho salmon in the winter of 1996-97, with a PL Index value of 174. Numbers fell considerably below this level for the following three years, but in 2000/01 they rebounded, with a PL index value of 103 fish, total carcasses numbering 65, and a total redd count of 86.

Table 30. Coho Salmon Spawning Survey Data for Olema Creek Mainstem

Year	Number of Surveys	Survey Area (km)	PDL Index	Total Carcasses	Total New Redds	Source
1994/95	3	13.4	53	1	9	Tomales Bay Association (TBA)
1995/96	2	13.4	106	37	n.a.	PRNS; TBA
1996/97	2	15.6	174	16	n.a.	PRNS; TBA
1997/98	8	13.4	88	39	126	PRNS
1998/99	6	15.0	42[a]	13	42	PRNS
1999/00[b]	2	7.2	9	9	10	PRNS
2000/01	4	11.8	103	65	86	PRNS
2001/02	4	11.8	90[c]	28	58	PRNS
2002/03	4	11.9	20	17	5	PRNS

a/ Includes two peaks, 7 weeks apart.
b/ Surveys missed peak numbers.
c/ Includes two peaks, 4 weeks apart
n.a. = not available.

Surveys have also been conducted on tributaries of Olema Creek and its headwaters, which is the section of creek above 17.4 km from its mouth. These surveys have confirmed spawning activity in five of the tributaries and in the Olema Creek headwaters. Except for the John West Fork and Quarry Gulch, coho observed have been within a few hundred meters of the mainstem confluence.

The John West Fork (aka Blueline Creek) is the most significant of the Olema Creek tributaries, having a greater average flow and more potentially suitable spawning habitat (2.2 km) than any other. A sharp drop below a culvert under Highway 1 previously limited access to most of the spawning habitat; during the two winters from 1997 to 1999 only 9% (3 of 33) of the total coho observations in the creek were above the culvert. In 1999, a structure was constructed to aid fish passage through the culvert. In the following four winters, 75% the total coho observations (146 of 194) were above the culvert. As part of this project, fencing to exclude cattle from 1 km of the creek was installed.

Table 31. Coho Salmon Spawning Survey Data for the John West Fork

Year	Number of Surveys	Survey Area (km)	PDL Index	Total Carcasses	Total New Redds	Source
1995/96	?	?	8[a]	n.a.	n.a.	PRNS
1996/97	n.a.	n.a.	n.a.	n.a.	n.a.	PRNS
1997/98	5	1.3	12	0	7	PRNS
1998/99	2	?	9	0	1	PRNS
1999/00[b]	3	1.1	18	0	7	PRNS
2000/01	4	1.9	58	30	48	PRNS
2001/02	6	1.8	20	5	31	PRNS
2002/03	7	1.3	27[c]	0	12	PRNS

a/ Includes live fish only, no carcass data.
b/ Surveys missed peak numbers.
c/ Includes two peaks, 4 weeks apart
n.a. = not available.

Starting in 1997, the CSRP has undertaken intensive survey work on Olema Creek to assess salmonid habitat condition and reproductive success. The focus of the CSRP is to correlate salmonid abundance at three life stages with habitat conditions to ascertain limiting factors on overall abundance. Index sites have been established along stream reaches representative of fish habitats and electrofishing is being used to determine juvenile coho and steelhead numbers. Results will be used to prioritize habitat restoration efforts and buffer threatened salmonid populations against potentially detrimental environmental conditions.

Data indicate that a high proportion of juvenile salmonids found in Olema Creek are located in the upstream, intermittent section above 11.9 km. A special study of the intermittent section of Olema Creek was conducted in 1999. Results indicate a significant loss of juveniles stranded in drying pools, which could be an important factor in reducing overall reproductive success in Olema Creek. Repeating this study, together with outmigrant trapping the following spring, could provide valuable information on the adequacy of Olema Creek juvenile salmonid habitat.

The CSRP also conducted a survey of in-stream salmonid habitat conditions on upper section Olema Creek (11.8-15.0 km). The survey found that much of the Olema Creek salmonid habitat may be sub-optimal due to high sediment loads that fill interstitial spaces in spawning gravel, fill pools, and reduce the overall stream volume.

The CSRP survey work to date shows that Olema Creek and its tributaries contain viable habitat for salmonids but there is not yet enough information to determine whether coho and steelhead populations are stable, increasing, or decreasing.

Drakes Bay Watersheds. The Drakes Bay watersheds include all those draining directly to the Bay from Double Point, north and west to Chimney Rock, with the exception of the watersheds within Drakes Estero (described as separate watershed unit). Watersheds south of Drakes Estero, such as Coast Camp Creek, Coast Creek, and Santa Maria Creek, are perennial systems known to support steelhead trout. In some watersheds, including Alamere Creek, rainbow trout (also *Oncorynchus mykiss*) occur above the natural migratory barriers. The watersheds to the west of Drakes Estero do not support either of the salmonid species within the park. The Drakes Bay watersheds include portions of five FMUs, including Headlands, Limantour Road, Palomarin, Wilderness North, and Wilderness South (see Table 11). Steelhead trout occur within all of the FMU areas with the exception of the Headlands.

Drakes Estero Watersheds. Watersheds draining to Drakes Estero including East and North Schooner, Glenbrook, Muddy Hollow, Home Ranch, and Laguna Creeks are known to support steelhead trout. Many sites within the Drakes Estero watershed are identified for restoration of fish passage as part of the Coastal Watershed Restoration Project. The Drakes Estero watershed includes portions of four FMUs, including Estero, Inverness Ridge, Limantour Road, and Wilderness North (see Table 11). Steelhead trout occur within each of these management units.

Pacific Drainages. While the Pacific drainages include portions of two FMUs, Headlands and Tomales Point, these watersheds do not support threatened salmonid species.

Bolinas Drainages. The Bolinas drainages include Arroyo Hondo Creek draining to the ocean, as well as Lewis Gulch and McKinnon Gulch draining to Bolinas Lagoon. Many of the Bolinas watersheds support perennial stream flow and steelhead trout. The Bolinas Drainage area includes the Bolinas Ridge, Highway One, and Palomarin FMUs. These management units represent 33% of the total drainage area (see Table 11). Each of the FMUs includes areas known to support steelhead trout.

The unique flow and fish habitat characteristics observed within Pine Gulch Creek. Approximately 75% of the watershed drains from Inverness Ridge, west of the San Andreas Fault. These perennial tributaries provide water to the mainstem, but climb immediately from the valley bottom, providing little to no salmonid habitat. The geologic formations west of the San Andreas Fault include the Santa Cruz Mudstone and Merced Formation (Clark et. al, 1984), which support deep soils with high infiltration capacity. The remaining 25% of the watershed drains from Bolinas Ridge east of the SAF. The Franciscan Complex, which supports very thin soils with very low capacity for infiltration, makes up Bolinas Ridge. Tributaries draining from Bolinas Ridge have topography and stream profiles appropriate to support salmonids. Except for

McCurdy Creek, all eastern tributaries are intermittent. The Pine Gulch Creek watershed includes two FMUs, Bolinas Ridge and Highway One, representing 23% of the total watershed area (see Table 11).

The watershed supports a population of steelhead and it is generally accepted that it supported a native self-sustaining population of coho salmon into the 1970s. The last observation of coho salmon documented in July of 1968 reads, "coho salmon, 20 fish per 100 foot length of stream" (CDFG, 1968). The reasons for extirpation of coho salmon in Pine Gulch are uncertain. It is likely that the drought of the late 1970s coupled with in-stream damming during the same period severely depleted multiple year classes and led to unsuitable conditions for continued survival of the species within the Pine Gulch watershed.

Following thirty years without documented coho sightings, recent NPS monitoring activities have detected the presence of three consecutive cohort year classes in Pine Gulch Creek. Beginning in winter 2000-2001, coho salmon spawners have been observed in low numbers (<5 per year) within the watershed. Modified Hankin-Reeves surveys yielded estimates of 589 (± 329) juvenile coho salmon in September 2001 and 1205 (± 337) juvenile coho salmon in September 2002. The 2002 survey results indicate higher abundance and wider distribution of coho than the 2001 survey. In response to juvenile presence in 2001, a smolt trap was operated in the spring of 2002 capturing 249 coho smolts (Ketcham & Brown, 2003). Evaluation of genetic samples indicate that coho salmon captured during summer 2001 in Pine Gulch Creek have a strong genetic affinity to coho in the Redwood Creek watershed, Marin County (Garza, personal communication), six miles to the south.

California Freshwater Shrimp (*Syncaris pacifica*)- Endangered

The California freshwater shrimp is the only extant member of the genus and is listed by the U.S. Fish and Wildlife Service as endangered (55 FR 43884). The shrimp is endemic to 16 coastal streams in Marin, Sonoma, and Napa counties north of San Francisco Bay, California. The shrimp is found in low elevation (<116 meters), low gradient (generally <1 percent), perennial freshwater streams with structural diversity, including undercut banks, exposed roots, overhanging woody debris, or overhanging vegetation. Existing populations are threatened by introduced fish; deterioration or loss of habitat resulting from water diversion and impoundment; livestock, dairy, and other agricultural activities and developments; flood control activities; gravel mining; timber harvesting; migration barriers; and water pollution. A study was recently conducted in PRNS and GGNRA to determine the distribution of California freshwater shrimp within streams in the parks, to evaluate the effectiveness of three survey methods for the shrimp, and to provide recommendations for survey techniques for long-term monitoring.

These shrimp reside in the Lagunitas and Olema Watersheds and depend on overhanging vegetation along the creek's banks for habitat. The shade provided by this vegetation is also important to the protection of rare fish species. Prescribed burning would incorporate a fixed setback from water resources to protect the water quality, the sensitive plant community and the listed fish species. The setback would also avoid adverse effects to the creek bank habitat important to the California freshwater shrimp.

The current range of the shrimp within Lagunitas Creek extends from Shafter Bridge in Samuel P. Taylor State Park to roughly 1.6 km below the confluence with Nicasio Creek (Serpa, 1991). Shrimp habitat along the main stem of Lagunitas Creek within the Parks is generally protected from agricultural activities occurring within the watershed. Small numbers of shrimp were collected in 1996 and 1997 near the confluence of Olema and Lagunitas creeks (Fong, 1999).

California Freshwater shrimp surveys detected small numbers of CA freshwater shrimp in lower Olema Creek in 2001. The USGS–BRD Dixon Field Station is conducting investigations of California freshwater shrimp habitat, survival, and predation within lower Olema and Lagunitas Creeks. This three-year investigation is looking at habitat and flow characteristics supporting the species and has found that native sculpin are a significant predator of the shrimp. Shrimp have not been found in the lower Olema Creek sections during this USGS investigation (LoBianco and Fong, 2002).

Myrtle's Silverspot Butterfly (*Speyeria zerene myrtleae*) – Endangered
Myrtle's silverspot butterflies inhabit coastal dune, coastal prairie, and coastal scrub habitats at elevations ranging from sea level to 300 meters, and as far as 5 kilometers inland (Launer et al., 1992). It was federally listed as endangered in 1992. Its historic distribution is believed to have extended from near Fort Ross south to Punta Ano Nuevo. By the 1970s populations south of the Golden Gate were believed to be extinct and extant; populations of the butterfly were believed to exist only within PRNS. Reasons for this decline include urban and agricultural development, changes in natural fire patterns, successional changes in plant communities have reduced availability of host plants, invasive non-native plants, livestock grazing, overcollecting, and other human impacts.

Following discovery of a population near the Estero de San Antonio in the early 1990s, field surveys were conducted by the Center for Conservation Biology at Stanford University. Two additional, apparently separate populations in PRNS were located and fieldwork was done to estimate populations' sizes. One population, centered on North Beach, extended from Abbotts Lagoon to South Beach and east to Drakes Estero and Drakes Beach. The highest numbers were found along the dune-scrub interface in the back dune area of the central peninsula on F and G ranches and the AT&T property, and on the bluffs on either side of the Drakes Beach visitor center. The population was estimated to number in the low thousands in 1993. Survey work in 1998 put the population estimate at 50-200 individuals, with no silverspots being found in portions of the 1993 range. The other population was found on the Tule Elk Reserve, with small numbers on the adjacent J Ranch. In 1993, the number of individuals in this population was estimated to be in the mid-hundreds. The 1997 survey of this northern Point Reyes population gave a population estimate of 250-500 (Launer et al., 1998).

Silverspot numbers in the area outside of parklands around the Estero de San Antonio were estimated at 2,000-5,000 individuals in 1991. Other nearby areas with potentially suitable habitat was not surveyed. Together with those found at Point Reyes, estimated numbers for the three known populations of the species total less than 10,000 individuals (USFWS, 1998).

Known Myrtle's silverspot nectar plants include curly-leaved monardella (*Monardella undulata*), yellow sand verbena (*Abronia latifolia*), seaside daisy (*Erigeron glaucus*), bull thistle *(Cirsium* *vulgare*), gum plant (*Grindelia* spp.), and mule ears (*Wyethia* spp.). Brownie thistle (*Cirsium quercetorum*) and groundsel (*Senecio* spp.) are also fed upon. Many of these species are commonly found at Point Reyes. Oregon silverspot (*Speyeria zerene hippolyta*) feeds on other common plant species that may also be used by Myrtle's silverspot.

Myrtle's silverspot larvae are known to use only one species as a host plant, western dog violet (*Viola adunca*). It is possible that, like other subspecies of *Speyeria zerene* and other species of silverspots, Myrtle's silverspot use other violet species as larval hosts, although this has not been observed. The perennial, rhizomatous western dog violet is found on open grassy slopes, sandy flats behind dunes, and on the edge of brush under pines (Howell, 1970). While it is described as "rather common near the coast," including the Point Reyes dunes, distribution of the species is patchy. Abundance of western dog violet alone is not a good predictor of silverspot presence. Myrtle's silverspot presence also is associated with protection from high coastal winds that are common during the summer flight season (Launer et al., 1992). The complex habitat needs of breeding Myrtle's silverspots may be the species' limiting factor.

Populations of Speyeria butterflies experience large population fluctuations, and population increases of tenfold or more in a single year has been observed. In 1994/95, California's central coast experienced a very wet winter that reduced numbers of many late-spring and summer-flying butterflies (silverspots are the latter). Another wet winter occurred in 1997-98, which may have resulted in the low numbers for the central Point Reyes population observed in summer, 1998.

Due to the lack of historic data previous to the 1990s, it is not known if the silverspot has declined at Point Reyes. While surveys of the two populations during the period 1993-1997 found that the Tule Elk Reserve population remained stable and the central Point Reyes population declined sharply, such variation is well within that normally found in Speyeria species (USFWS, 1998).

A Masters thesis project, which will include mapping the distribution of larval host and nectar plants at PRNS and monitoring the response of these species to different grazing regimes is currently being developed by a member of PRNS Resource Management staff. Additionally, plant species composition response to tule elk grazing and to exclusion from grazing is being assessed as part of long-term monitoring of vegetation in the Tule Elk Reserve. Together with continued censusing of Myrtle's silverspot numbers, this research will help provide the needed grazing management information identified by the Myrtle's silverspot recovery plan (USFWS, 1998).

<u>Western snowy plover (*Charadrius alexandrinus nivosus*) – Threatened</u>

Western snowy plovers use the Point Reyes peninsula as both wintering and nesting habitat. Wintering birds occur around Drake's Estero and Abbott's Lagoon, and along Limantour Spit and the Great Beach. During the 1980s nesting took place along the entire Great Beach, Drake's Beach, and at Limantour Spit. In recent years, erosion along the southern portion of the Great Beach has diminished the upper beach area such that the entire beach can be washed by waves. Nesting is occurring on the northern portion of this beach, between the North Beach parking area and Kehoe Beach, which is backed by extensive dunes. Snowy plovers also nest along the western edge of Abbott's Lagoon. Although it had historically been used as nesting habitat by plovers, erosion has affected Limantour Spit and it no nests have been seen since 2000. In 2001 and 2002, all snowy plover nests observed were located on the northern portion of the Great Beach.

Monitoring of nesting snowy plovers in 1986-1989 and 1995-2002 indicates a decline in the number of nesting birds through 1996, followed by a gradual rebound (Table 32). Point Reyes Bird Observatory (PRBO) monitored individual nests at all nesting areas during this period. On the Great Beach, where most nesting took place, the number of chicks fledged per egg laid during 1986-89 and 1995 ranged from 1%-7%.

Table 32. Snowy plover Nesting at PRNS.

Year	Number of nests	Number of nesting birds	Number of chicks fledged	Percent chicks fledged per egg laid
1986	41	41-44	5	5
1987	74	50-54	15	7
1988	63	40-42	5	3
1989	60	34-37	1	1
1995	20	12	4	7
1996	9	10-11	14	58
1997	25	25	20	45
1998	14	16	21	58
1999	21	20	22	47
2000	28	31-37	14	19-20
2001	34	27-36	10	11-12
2002	30	34-37	17	22
2003	22	25	19	

In 1996 a program to increase snowy plover nesting success was initiated, and this program continues to the present. Several nesting areas, including Limantour Spit and sections of the Great Beach accessed by the Abbott's Lagoon and Kehoe Beach trails, experience regular visitor use. In response, PRNS ropes off sensitive habitat and posts signs to divert visitor traffic. Visitors are advised to avoid walking on upper beach areas used by plovers, and dogs are prohibited from nesting areas. In 2000, observers found a higher rate of snowy plover chick loss in these areas on weekends, when disturbance by human visitors and dogs is more likely. In 2001, the Seashore initiated a snowy plover weekend docent program to increase awareness of plover habitat restrictions. Starting in 1996, exclosures were placed over plover nests to reduce avian and mammalian predation. Since the use of exclosures in 1995, the rate of chicks fledged per egg has increased to 20%-58% (Ruhlen and Abbott, 2000), and between one and three chicks per female have fledged. In 2000, although egg laying remained high, fledging rate started to decline. Causes for the decline likely includes predation by ravens, raptors, and disturbance by visitors. Ravens have been identified as the primary predator of eggs of plovers and any activities that increase the presence or productivity of ravens would potentially have a negative effect on the plovers. Ravens could benefit from prescribed fires by foraging on fleeing wildlife such as reptiles and rodents.

Fledging rates for snowy plovers before nest protection began were insufficient to maintain the species at PRNS, as indicated by declining numbers of nests and nesting adults in the period 1986-1995. Continuation of such low nest success rates could have resulted in loss of the PRNS breeding population of snowy plover. The current nest protection program has raised nest success rates to levels similar to those at other coastal California locations.

Additional Special Status Wildlife

Table 33 lists several animal species in the project area that are federal Species of Concern or listed by the state of California. In the federal system, Species of Concern are those where USFWS is collecting additional information to determine whether they warrant consideration for future listing. Table 33 lists nine species of mammals, 22 species of birds, three reptiles, two species of amphibians, three fish, and ten species of invertebrates. The table also shows which species are potentially subject to adverse effects. Because it may be more likely than other species to experience effects from fire or fire management activities, the Point Reyes Mountain Beaver is discussed in more detail below.

Point Reyes Mountain Beaver (Aplodontia rufa phaea) - Federal Species of Concern.

The US Fish and Wildlife Service and the California Department of Fish and Game list the Point Reyes mountain beaver, a muskrat-sized rodent found only in scrub habitat in western Marin, as a Species of Concern. Mountain beaver may be adversely affected by actions described in the Fire Management Plan alternatives, but most particularly by large-scale unplanned ignitions. Studies conducted following the 1995 Vision Fire in Point Reyes revealed that Point Reyes mountain beaver suffered high mortality. Surveys indicated that pre-fire estimates of approximately 5,000 individuals were in the burned area. After the Vision Fire, major changes in the habitat occurred. For example, there was a reduction in coastal scrub to charred sword fern bases and blackened skeletons of coyote brush. Post Vision Fire surveys suggested that only 19 mountain beavers survived within the surveyed fire area. This number represents only 0.4 – 1.2% of the population that park staff estimate had previously inhabited the surveyed area (Fellers et al., 2003). It is likely that the post-fire mortality was related to dehydration as this species requires up to two cups of water per day, normally provided through roots and vegetation, to survive. Monitoring in the years following the fire indicate that recovery of the populations has been slow (Fellers, 2000). Populations on the peninsula outside of the area burned in the Vision Fire remain healthy (Fellers, pers. comm. 2003).

Table 33. Animal Species of Concern and California-listed Species That May Occur in Areas Affected by PORE's Fire Management Plan (per USFWS Letter, May 24, 2001)

Common Name	Scientific Name	Known to Occur	Potentially Subject to Adverse Impacts
Mammals			
California myotis bat	*Myotis californicus*	yes	yes
Fringed myotis bat	*Myotis thysanodes*	yes	yes
Greater western mastiff-bat	*Eumops perotis califomicus*	no	no
Long-eared myotis bat	*Myotis evotis*	yes	yes

Long-legged myotis bat	*Myotis volans*	yes	yes
Pacific western big-eared bat	*Corynorhinus (Plecotus) townsendii townsendii*	yes	yes
Point Reyes jumping mouse	*Zapus trinotatus orarius*	yes	yes
Point Reyes mountain beaver	*Aplodontia rufa phaea*	yes	yes
Yuma myotis bat	*Myotis yumanensis*	yes	yes
Birds			
Allen's hummingbird	*Selasphorus sasin*	yes	yes
American bittern	*Botaurus lentiginosus*	yes	no
Ashy storm petrel	*Oceanodroma homochroa*	yes	no
Bank swallow (CT)[a]	*Riparia riparia*	no	no
Bell's sage sparrow	*Amphispiza belli belli*	no	no
Bewick's wren	*Thryomanes bewickii*	yes	yes
Black rail (CT)[a]	*Laterallus jamaicensis coturniculus*	yes	no
Black-crowned night heron	*Nycticorax nycticorax*	yes	no
Common loon	*Gavia immer*	yes	no
Ferruginous hawk	*Buteo regalis*	rare	no
Grasshopper sparrow	Ammodramus savannarum	yes	yes
Harlequin duck	*Histrionicus histrionicus*	rare	no
Little willow flycatcher (CE)[b]	*Empidonax traillii brewsteri*	no	no
Loggerhead shrike	*Lanius ludovicianus*	rare	no
Long-billed curlew	*Numenius americanus*	yes	no
Olive-sided flycatcher	*Contopus cooperi*	yes	yes
Pacific-slope flycatcher	*Empidonax difficilus*	yes	yes
Rufous hummingbird	*Selasphorus rufus*	no	no
Saltmarsh common yellowthroat	*Geothlypis trichas sinuosa*	yes	no
Short-eared owl	*Asio flammeus*	yes	yes
Tricolored blackbird	*Agelaius tricolor*	yes	yes
Vaux's swift	*Chaetura vauxi*	yes	no
White-tailed (=black shouldered) kite	*Elanus leucurus*	yes	yes
Reptiles			
California horned lizard	*Phrynosoma coronatum frontale*	no	no
Northwestern pond turtle	*Clemmys marmorata marmorata*	yes	no
Alameda striped racer	*Masticophis lateralis euryxanthus*	no	no
Amphibians			
Foothill yellow-legged frog	*Rana boylii*	no	no
Northern red-legged frog	*Rana aurora aurora*	no	no
Fish			
Longfin smelt	*Spirinchus thaleichthys*	no	no
Pacific lamprey	*Lampetra tridentata*	yes	no
Tomales roach	*Lavinia symmetricus* ssp.	yes	no
Invertebrates			
Bumblebee scarab beetle	*Lichnanthe ursina*	yes	
Globose dune beetle	*Coelus globosus*	yes	no

Marin elfin butterfly	*Incisalia mossii*	unknown	unknown
Nicklin's peninsula Coast Range snail	*Helminthoglypta nickliniana awania*	unknown	unknown
Oplers longhorn moth	*Adela oplerella*	unknown	unknown
Point Reyes blue butterfly	*Icaricia icaridides ssp*	yes	yes
Ricksecker's water scavenger beetle	*Hydrochara rickseckeri*	no	no
sandy beach tiger beetle	*Cicindela hirticollis gravida*	yes	no
Sonoma arctic skipper	*Carterocephalus paleemon ssp*	unknown	unknown
William's bronze shoulderband snail	*Helminthoglypta arrosa williamsi*	unknown	unknown

a/ CT: Listed as threatened under the California Endangered Species Act b/ CE: Listed as endangered under the California Endangered Species Act

Habitats of Management Concern

Numerous habitat types within the project area are afforded protection under various laws and regulations. Through the 1997 Magnesun-Stevens Act, the National Marine Fisheries Service (NMFS or NOAA Fisheries) has designated all streams on NPS lands as Essential Fish Habitat (EFH). EFH waters support a variety of fish species. The USFWS has designated critical habitat for the protection of the California red-legged frog, which includes nearly all of the land within the project area.

Cultural Resources

In addition to a diverse mosaic of natural and physical features, Point Reyes contains a varied array of cultural resources within its boundaries. The NPS recognizes five types of cultural resources: archeological resources, structures, ethnographic resources, cultural landscapes, and museum objects. Archeological resources "are the remains of past human activity and records documenting the scientific analysis of these remains." These include artifacts, ecofacts, and features. Structures "are material assemblies that extend the limits of human capacity," and comprise such diverse objects as buildings, bridges, vehicles, monuments, vessels, fences, and canals. Ethnographic resources "are basic expressions of human culture and the basis for continuity of cultural systems" and encompasses both the tangible (native languages, subsistence activities) and intangible (oral traditions, religious beliefs). The management of ethnographic resources entails the recognition that traditional cultures can have different worldviews and the right to maintain their traditions. Cultural landscapes "are settings we have created in the natural world." They are intertwined patterns of natural and constructed features that represent human manipulation and adaptation of the land. Finally, museum objects "are manifestations and records of behavior and ideas that span the breadth of human experience and depth of natural history." Examples of typical museum objects include field and laboratory notes, artifacts, and photographs.

Historical Overview

Cultural resources abound on the Point Reyes peninsula. The Coast Miwok people inhabited the area for more than 2000 years before European explorers arrived, and human population density before contact was probably greater than it is today (Cook, 1943). At least 124 Native American archeological sites exist within PRNS, primarily on the coastal lowlands. These known prehistoric sites are primarily “shell middens,” voluminous deposits of soil with a relatively high content of local shell that were created as a byproduct of human habitation or use of the site. The shell reflects the harvest of shellfish by the Coast Miwok as both food and raw material for the manufacture of shell beads, ornaments, and tools.

The interior core of the peninsula has not yet been surveyed for archeological sites, due in part to a combination of thick vegetation and rugged topography. The NPS recently estimated that between 41 and 123 additional Native American archeological sites are present within its boundaries. Ironically, these areas that have not been surveyed because of topographic constraints or thick vegetation may be those where fire would be most intense and likely to inflict damage.

The ethnographic Coast Miwok were a hunting and gathering people who harvested diverse, naturally occurring terrestrial and aquatic foods and materials. They created tools, clothing, weapons, structures, ornaments, baskets, and other items of material culture using resources that were primarily local but sometimes traded (e.g., obsidian). In addition they likely manipulated the local environment through limited burning to favor the reproduction of selected plant and animal species. Their settlement pattern is thought to reflect the “tribelet” model common to many Californian groups. In this model comparatively fewer and larger permanent village sites were each affiliated with several or smaller, semi-permanent villages or seasonally occupied habitation sites. These smaller sites were devoted to the harvest of specific, localized natural resources as they became available during the annual cycle. Coast Miwok people currently live in the area and are federally recognized as the Federated Indians of Graton Rancheria.

Most experts believe that Point Reyes contains the site of the first recorded English/Native American contact in North America. According to experts, Francis Drake is likely to have landed here in 1579 to careen his ship before sailing across the Pacific on a circumnavigation of the globe. In 1595 the first recorded shipwreck on the West Coast occurred when the Spanish galleon San Augustin wrecked in what is now Drake’s Bay. Since that year, Point Reyes history is replete with accounts of shipwrecks and underwater archeological surveys have been conducted to identify and record several of them. It was Spanish sailor explorer Sebastian Vizcaino who named Point Reyes (Punta de los Reyes) in 1602.

In the late 1700s and early 1800s the Spanish colonized California using the “Mission System.” The key Missions affecting the Coast Miwok were San Francisco de Asís (1776), San Rafael Arcángel (1817), and San Francisco Solano De Sonoma (1823). The Coast Miwok were encouraged and sometimes forced to remove from their local lands to the missions where they were further indoctrinated in the Catholic religion and assimilated into the Spanish colonial culture and economy. The profound changes in land use and economy initiated by the Spanish generally left them little choice if they were to survive at all. This eventually resulted in the almost complete collapse of the Coast Miwok people and culture and included the loss of most of their oral tradition.

In response to the many shipwrecks in treacherous coastal waters, the federal government established lighthouse and life-saving stations in the late 1800s and early 1900s. The historic Point Reyes Lighthouse was in service from 1870 to 1975. During that time, it endured many hardships, including the 1906 earthquake. Forty-five shipwrecks occurred during the first 60 years of the Lighthouse’s operation. Because of this ongoing problem, the U.S. Life-Saving Service established a life-saving station on the Great Beach in 1890. Four years later it was moved to Drakes Bay. The U.S. Coast Guard assumed the operation in 1915 and upgraded it in 1927. The life-saving station was designated a National Historical Landmark in 1989. The Lighthouse was listed on the National Register of Historic Places in 1978.

PRNS is home to the Marconi/RCA receiving and transmitting stations, which together with the Marconi receiving station site at Marshall (now the State Park-owned Marconi Conference Center) form the only known intact coast wireless station remaining in the United States dating from the birth of wireless communications. The Bolinas transmitting station was the site of the first trans-Pacific wireless communication in 1913. The two stations have been adaptively rehabilitated for park administrative and tenant office use, but retain significant historical radio equipment and antennas in operational condition. The sites are maintained and operated by park staff with significant assistance from park volunteers from the maritime Radio Historic Society.

Archeological Resources

Archeological resources typically consist of sites or isolated artifacts. In terms of location and period of origin archeological resources can be generally categorized as terrestrial or submerged, and either as prehistoric or historic. Prehistoric archeological sites may also include “protohistoric” components that reflect Coast Miwok occupation or use during the historic era, or that may contain early historic artifacts such as porcelain fragments originating from the Drake and Cermeno voyages. Historic archeological sites may also include or be in direct association with standing or ruined structures. Within PRNS, submerged archeological sites are typically historic shipwrecks that are either fully or partially submerged at high tide. Some sites include both prehistoric and historic components. Sites may singly or in combination contribute to, or even constitute cultural landscapes depending upon the character of their visible remains or landscape signatures. The Park estimates that approximately 87% of its terrestrial acres have not yet been surveyed for archeological resources. Archeological resources can be significant under any or all four criteria of the National Register of Historic Places.

In 2002 the Park determined that there were at least 124 recorded prehistoric, terrestrial sites. It was also estimated that there were from 41 to 123 additional, unknown terrestrial prehistoric sites within current Park boundaries. The highest probability for unknown prehistoric sites would be in the Tomales Point FMU, Limantour FMU, Headlands FUM, Highway One FMU, and Palomarin FMU because of their proximity to water and food resources. These sites are either habitation or use sites that reflect Coast Miwok occupation or resource processing sites. As described in the above *Historical Overview* most of the known prehistoric sites are shell middens of various sizes. Shell middens often contain a wide variety of cultural resources including, for example, human remains; cooking or food processing features (e.g., bedrock mortars); obsidian, chert and bone tools; shell ornaments; and the faunal remains of species harvested for food and materials. The depositional history reflected by a site’s stratigraphy or layering, and the spatial organization of its contents are often critical for dating, understanding and interpreting Coast Miwok lifeways and cultural change over time. The geographic distribution of prehistoric sites on the land is important in itself for the information it can provide on Coast Miwok settlement systems.

The park also has counted 92 historic terrestrial archeological sites that have been recorded in various documents at different levels of intensity. In addition, it was estimated that 5 to 37 additional, unknown, historic terrestrial sites are likely to exist within the boundaries of PRNS. These sites typically reflect historic occupations and use of the peninsula; first by homesteaders and dairy ranch communities, and later by government lighthouse and lifesaving personnel and private radio telecommunications companies. They range in size and complexity from discrete trash pits containing old bottles, tins, broken tools and crockery; to now buried corduroy roads, ruined ranch sites, and radio communication facilities complete with antennae farms. As with prehistoric archeological sites, maintaining the integrity of the deposits or remains is crucial to understanding and interpreting them. Historic archival research is often important in predicting the location of such sites and also understanding what they once were and how they functioned.

Park cultural resource staff has also counted 9 known and recorded terrestrial archeological sites that contain both prehistoric and historic components (not necessarily related to each other). They estimate another 5 to 14 such sites within park boundaries exist but have not yet been identified.

The recently completed Point Reyes National Seashore Cultural Affiliation Report examining Native American affiliation at Point Reyes concluded that the Federated Coast Miwok people have a clear, exclusive affiliation with the lands managed by Point Reyes National Seashore extending back more than 2000 years. The Federated Coast Miwok are politically recognized by the federal government as the Federated Indians of Graton Rancheria.

Cultural Landscapes

PRNS manages 39 cultural landscapes; 23 are within the boundaries of Point Reyes National Seashore and 16 are within the North District of GGNRA. The landscapes primarily reflect the maritime, ranching, communications, and military history of the park. Two are ranching districts, which together comprise approximately 30,000 acres of parkland in the northern district of Point Reyes and the Olema Valley. Two other landscapes have national significance: the Lifeboat Station is a National Landmark and the Marconi/RCA sites (described above) are in the process of being nominated to the national register. Cultural landscapes identified in the NPS Cultural Landscapes Automated Information Management System (CLAIMS) are listed below in Table 34.

Table 34. Cultural Landscapes

Landscape Name	CLAIMS #	Location
Bolinas Copper Mines	725194	Hwy One FMU, Olema Valley, GOGA
Hamlet	725193	Not in FMU, Tomales Bay, GOGA*
North Pacific Coast Railroad Grade	725195	Bolinas Ridge FMU, Lagunitas Loop & Tomales Bay, GOGA
Olema Valley Ranches Historic District	725001	Highway One FMU, Olema Valley, GOGA
Cheda Ranch	725209	Not in FMU, Lagunitas Loop, GOGA
Five Brooks	725197	Wilderness South FMU, Olema Valley ,GOGA
Hagmaier Ranch	725212	Highway One FMU, Olema Valley, GOGA
McFadden Ranch	725203	Not in FMU, Olema Valley, GOGA

Landscape Name	CLAIMS #	Location
McIsaac Ranch	725206	Not in FMU, Lagunitas Loop, GOGA
Ralph Giacomini Ranch	725014	Highway One Fmu, Olema Valley, GOGA
Stewart Ranch	725199	Wilderness South FMU, Olema Valley – GOGA
Teixeira Ranch	725211	Highway One FMU, Olema Valley, PORE
Truttman Ranch	725200	Not in FMU, Olema Valley, GOGA
Wilkin's Ranch	725003	Highway One FMU, Olema Valley, GOGA
Zanardi Ranch	725191	Not in FMU, Lagunitas Loop, GOGA
Tomales Bay Highway One	725482	Not in FMU, Tomales Bay, GOGA
Coast Guard Facilities	725161	Not in FMU, North District – PORE
Coast Guard Lifesaving Station & Navy Radio Direction Finder Station	725190	Not in FMU, South Beach – PORE
Point Reyes Lifeboat Station	725182	Headlands FMU, PORE
Point Reyes Lighthouse	725183	Headlands FMU, PORE
Coastal Defense Sites	725160	North & South District , PORE
Bolinas Military Reservation	725185	Palomarin FMU, PORE
Drakes Bay Artillery Installation	725186	Not in FMU, North District , PORE
SCR Radar Site	725184	Not in FMU, North District, PORE
Wildcat Military Reservation	725187	Wilderness South FMU, North District, PORE
Laird's Landing	725159	Not in FMU, Tomales Bay, PORE
Olema Lime Kilns	725158	Highway One FMU, Olema Valley, PORE
Point Reyes Ranches Historic District	725005	Not in FMU, North District, PORE
A Ranch	725012	Headlands FMU, PORE
B Ranch	725016	Not in FMU, North District, PORE
C Ranch	725017	Not in FMU, North District, PORE
D Ranch	725011	Not in FMU, North District, PORE
Home Ranch	725006	Estero FMU, North District, PORE
I Ranch	725167	Not in FMU, North District – PORE
L Ranch	725013	Not in FMU, North District, PORE
Upper Pierce Ranch	725177	Tomales Point FMU, North District, PORE
RCA Marine Radio Station	725162	Not in FMU, North & South Districts, PORE
RCA Receiving Station	725188	Not in FMU, North District – PORE
RCA Transmitting Station	725189	Not in FMU, Palomarin/Bolinas - PORE

*Not in FMU indicates that cultural landscape area is outside a Fire Management Unit that is proposed for treatment.

Structures

Over 300 hundred historic structures are found on land managed by PRNS. The majority of these structures are located outside the FMUs to be treated; however, the Headlands, Tomales Point, and Highway One FMUs do have some historic structures. The structures range from simple timber-framed barns to the cast-iron Point Reyes Lighthouse to the concrete Mission Revival Marconi transmitting station. Historic structures are found throughout most of the park (none in the wilderness area) and mark the built history of PRNS.

Approximately two thirds of PRNS's listed structures are ranch structures managed under leases and permits. The remaining structures primarily reflect the Park's maritime and radio communication history. Four sites are listed on the National Register, including the Point Reyes Lifeboat Station - a National Historic Landmark. Three additional properties have been determined eligible for the National Register and several additional properties are in review (see Table 35). 297 historic structures are on the List of Classified Structures, the NPS inventory of historic and prehistoric structures.

Table 35. National Register Status

NR Status	Property Name	Property Type & Date
National Register Listed	Olema Lime Kilns, #76000217, 10/08/76	structure/site, c. 1850
	Point Reyes Lifeboat Station, #85002756, 11/07/85	complex of buildings/features, c. 1927
	Designated as NHL 12/20/89	
	Upper Pierce Ranch, #85003324, 12/06/85	complex of buildings/features, c. 1858-1935
	Point Reyes Light Station, #91001100, 09/03/91	complex of buildings/features, c. 1870-1960
Determined Eligible	Sarah Seaver Randall House (GOGA) 08/29/79	single house, c. 1880
	Olema Valley Rural Historic District (GOGA) 01/02/79. Revision & resubmittal in progress.	district, c. 1834-present
	Hamlet (Jensen's Oyster Beds) (GOGA) 01/24/90	complex of buildings/features, c. 1900-1945
	Point Reyes NS Rural Historic Landscape District 04/03/95	district c. 1834-present
National Register Submittal Pending	Point Reyes Peninsula Archeological District	district, prehistoric
Determination of Eligibility Pending	Marconi/RCA Receiving and Transmitting Stations (in review)	complex of buildings/features, c. 1914-1945
	Bolinas Copper Mines (GOGA) (in review)	ruins/site, c. 1863-1918
	North Pacific Coast RR Grade (GOGA) (in review)	linear structure/sites, c. 1873-1933
	Tocaloma Bridge (GOGA) (in review)	single structure, c. 1927

Visitor Use and Visitor Experience

The project area is unique not only in its assemblage of natural and cultural features, but also in its proximity to a major urban population. This juxtaposition makes PRNS's resources and recreational opportunities readily accessible to a large number of people, and enhances the importance of the special qualities for which it was set aside. Over 2.25 million people visit PRNS annually. Visitation estimates for 2002 found that the North District of the park (north of Bear Valley) receives roughly 60% of the overall visitation. Over 700,000 visitors went to the 3 park visitor centers and over 70,000 visitors have extended contacts with park interpretive staff through ranger-led programs.

The area supports 147 miles of hiking trails, backcountry campgrounds, and numerous beaches. Activities include hiking, water sports, horseback riding, fishing, camping, wildlife viewing, and other interpretive opportunities.

Hiking is primarily a day-use activity. Approximately 50 trails are designated throughout PRNS, and they encompass a range of habitat types from wooded mountains to sandy beaches. Overnight stays are available through 4 backcountry campgrounds, the Stewart Horse Camp, the Point Reyes Hostel, a private campground, and local hotels and inns. Dozens of visitors bring horses to ride on designated horse trails, and hundreds rent horses every week from commercial stables.

Water sports include kayaking, canoeing, boating, and swimming. The majority of paddle crafts use Tomales Bay as it provides protection from ocean waves and surf, while power boaters more freely use the ocean. Though Stinson Beach and Bolinas attract more surfers, North Beach is known as a challenging surfing area. Nature study and wildlife viewing are important activities at Point Reyes. Visitors make special trips to PRNS to see migrating whales, shorebirds, breeding elephant seals, tule elk, and spring wildflowers. Information received from visitor surveys conducted by Sonoma State University (NPS, 1997 and NPS, 1998) found that most park visitors spend 2-6 hours at PRNS in a variety of activities dependent upon the season, ranging from whale watching and kayaking to hiking and bird watching.

The NPS gathers standardized annual surveys for each park unit to determine the percent of visitor satisfaction based on park facilities, visitor services, and recreational opportunities. During Fiscal Year 2002, based on a random visitor survey conducted by the University of Idaho, the park received a 98% visitor satisfaction ranking (NPS, 2002a).

<u>Tomales Point FMU</u>. Approximately 500,000 visitors a year visit Pierce Point Ranch and use the trails in the Tomales Point FMU. An important draw to the area is the trail to the tip of Tomales Point and the opportunity to see the tule elk herds. One out of five visitors will also stop at McClures or Kehoe Beach while in this northernmost portion of the park. Kayakers from the east side of Tomales Bay will pull out along the east coast beaches; overnight camping on the beach is permitted. Tomales Point provides solitude and vistas of Tomales Bay and the Ocean. Park docents provide information to visitors during the Tule elk rutting season from August to early October. The area is designated wilderness (with the exception of a buffer along Pierce Point Road) and no bicycles are allowed.

<u>Headlands FMU</u>. During the whale-watching season (December through April), the demand for visitation to the Headlands is so high and parking so limited that private vehicle use is restricted on weekends and visitors are shifted to a shuttle bus system. Sea lions, tule elk, shorebirds, and spring wildflowers all attract their share of eager observers. Year-round the historic lighthouse and Chimney Rock trail are heavily visited and unlike most areas of the park, visitors are relatively concentrated as they climb the lighthouse stairs or walk the short trail to Chimney Rock. Park staff provide interpretive programs on whales, wildflowers, pinnepeds, the lifeboat station, and the lighthouse. Lighthouse tours are also conducted once or twice a month in the evening. School programs are popular on weekdays during the school year. From June to September, most interpretive programs are held on the weekends.

<u>Inverness Ridge FMU</u>. The principal visitor use in this FMU is hiking and some bicycling. The experience is largely one of solitude and of wide vistas taking in the 1995 burn area, Tomales Bay, and the Ocean.

<u>Estero FMU.</u> The trail network in the Drakes Estero FMU does not receive high numbers of visitors according to monthly visitation counts. Portions of the trail network are open to bicyclists. The Estero is the site of harbor seal pupping from March 15 to June 30th. Other times of the year kayaks may put into the Estero from the area near Johnson's Oyster Farm. The trail network is very popular year-round with birdwatchers and hikers.

Palomarin FMU. Primarily wilderness, visitors hike to the coast to see harbor seals and go down to the tidepools. The experience is largely solitary with a view of the coastline north to the lighthouse. Visitors hike into Bass Lake to swim. No bicycles are allowed. The area is popular with birdwatchers and PRBO runs volunteer programs and research mist netting programs.

Highway One FMU. Visitors bicycle and horseback ride along the Olema Valley Trail and swim naked in Hagmeier Pond. Much of the visitation is from the highway corridor with occasional wildlife viewing at pulloffs. Mountain bikers can access the Bolinas Ridge Trail via McCurdy and Randall Trail.

Bolinas Ridge FMU. Hiking and biking on the Bolinas Ridge Trail and connecting McCurdy and Randall Trails attracts roughly 35,000 visitors a year. Visitation is relatively light and the experience is solitary though traffic noise from Highway One is perceptible.

Limantour FMU. The eastern portion of Limantour FMU includes the administrative offices and visitor center at Bear Valley. Nearly 700,000 visitors come to the visitor center annually and many continue to the Earthquake trail or Bear Valley trail. The Limantour and the Headlands FMUs have the highest visitor concentrations. Once visitors hike beyond the Bear Valley Trail to backcountry trails, the experience is remote from urban influences, though other hikers are seen regularly on the trails. Limantour Beach at the western end of the FMU is the closest beach to Highway One and the destination for approximately 180,000 visitors at year. The American Youth Hostel is sited in this FMU as is the Clem Miller Environmental Education Center. The Center has residential programs during the school year and service camps and weekend seminars in the summer months. The Limantour parking area is one of several points used to hike to the backcountry campsites.

Wilderness North and South. Accessed from the Bear Valley Visitor Center, Five Brooks, and Limantour Road, the wilderness trails are popular with day hikers, backpackers, and horseback riders. A corridor through the wilderness permits mountain bikers to use trails to reach the backcountry campground. The trails get regular use and other trail users are frequently passed.

Park Operations

Staffing and Facilities

The park has an outstanding and dedicated staff. Currently the park has about 90 permanent staff, 23 term employees, and 47 temporary staff working on a variety of projects and programs. This represents about 115 FTE (full time equivalents or one person for a full year). During the peak summer months, the park staff increases to about 160 staff members, including Youth Conservation Corps enrollees who provide assistance in a number of ways to Point Reyes National Seashore. This work force is supplemented by 20,000 hours of Volunteers-in-Parks service, three Student Conservation Assistants, and AmeriCorps.

The Fire Management Office is staffed by a Fire Management Officer, a program analyst, a hazardous fuels specialist, an eight-person hazard fuels crew, one engine foreman, and a four-person engine crew. Three fire staff members are also trained as emergency medical technicians at the basic life support level. Providing technical assistance to both the fire management offices at PRNS and GGNRA are technical staff including a GIS technical specialist, an education specialist, and an environmental planner. PRNS, GGNRA, and Pinnacles share a fire ecologist and a team of five fire effects monitors. PRNS has mutual aid agreements with Marin County Fire Department, Bolinas Fire Protection District, Inverness Public Utility District, and Nicasio Volunteer Fire Department. While PRNS has direct protection authority for federal lands, Marin County has been given "delegated initial attack responsibility" for these same lands. This allows Marin County to assume authority of initial suppression actions until Seashore firefighters arrive.

PRNS (including GGNRA North District) maintains the necessary infrastructure to support an annual park visitation of 2.25 million people, provide offices, support structures and limited housing for the permanent and seasonal park staff. Park structures include:

- 3 visitor centers
- 2 environmental education centers
- 30 restroom complexes
- 4 backcountry campgrounds
- 17 water systems
- 147 miles of trails
- Over 100 miles of roads
- Over 100 public and administrative structures, and
- 27 sewage treatment systems

PRNS also manages and protects park cultural resources including:

- 297 historic structures
- 127 recorded archaeological sites
- 11 identified cultural landscapes
- 498,000 museum objects

Financial resources available to achieve the park's annual goals include a base-operating budget of approximately $4,900,000. In addition, the park receives supplemental support for fire operations, cyclic maintenance, special natural resource projects, and repair and rehabilitation of structures. Fire funding for operations is approximately $770,000 annually for wildfire suppression, mechanical treatments, and prescribed fire. For the last three years, Point Reyes and GGNRA have received an additional $700,000 annually for Wildland Urban Interface (WUI) projects. Staffing for all aspects for fire management is approximately 13 FTE's.

Commercial Leases/Permits

Apart from the NPS program, there are numerous commercial leases within PRNS operating businesses, farms, ranches, and an aquaculture production. Leases include:

- 7 dairies
- 19 beef cattle ranches
- Silage production on approximately 1,000 acres of land,

- Oyster production in Drakes Estero, and
- Water supply to Bolinas Community

Wilderness Operations

More than half of PRNS, the 32,373-acre Philip Burton Wilderness Area, must be managed in conformance with the 1964 Wilderness Act, NPS Management Policies (NPS 2000, Chapter 6), and the Director's Order and Reference Manual 41 for Wilderness Preservation and Management. Generally, the public purpose of wilderness in the national parks includes the preservation of wilderness character and wilderness resources in an unimpaired condition, as well as for the purposes of recreational, scenic, scientific, educational, conservation, and historical use. Management includes the protection of the areas, the preservation of the wilderness character, and the gathering and dissemination of information regarding their use and enjoyment as wilderness.

The Wilderness Act requires that, except as necessary to meet the minimum requirements for the administration of a wilderness area, "there shall be no temporary roads, no use of motor vehicles, motorized equipment or motorboats, no landing of aircraft, or no other form of mechanical transport, and no structure or installation" within the wilderness. (16 U.S.C. 1131 et seq., Section 4 (c))

<u>Prescribed Fire and Fuel Reduction</u>. Actions proposed under the FMP, such as prescribed burns and vegetation management actions, would be conducted to provide information to support objectives to return wilderness habitats to a more natural fire return internal conforming to data in the fire history record.

As required by the Wilderness Act, actions necessary to prepare and execute prescribed burns, fuel reduction activities, and resource enhancement projects must be examined to assure that they are necessary. If so, the park is required to use the least invasive methods possible to carry out the needed treatment. This "minimum requirement" process is designed to ensure the least disturbance and disruption of wilderness values and maximum protection of natural and cultural resources. At PRNS, the examination of minimum requirements is undertaken and documented by the interdisciplinary team reviewing projects for compliance to the National Environmental Policy Act.

NPS Management Policies (NPS, 2000, §6.3.5) outline the minimum requirement concept as a two-step process to determine: 1) whether the proposed management action is appropriate or necessary for administration of the area as wilderness and does not pose a significant impact to wilderness resources and character; and 2) which techniques and types of equipment should be used to ensure that impact to wilderness resources and character is minimized.

If no strategy can be developed without seriously affecting wilderness resources or character, only actions that ultimately preserve wilderness character and/or have only localized, short-term adverse impacts can be implemented. In effect, the benefits must outweigh the impact and the decision must be well documented.

Use of motorized equipment and/or mechanical transport can be allowed only: If determined by the superintendent to be the minimum requirement needed by management to achieve the purposes of the area as wilderness, including the preservation of wilderness character and values; or In emergency situations (search and rescue) involving the health or safety of persons actually within the area. Such management activities would be conducted in accordance with all applicable regulations, policies, and guidelines, including minimum requirement protocols as practicable.

Suppression of Wildland Fire. Director's Order 41 (1999) states that all wildland fires within wilderness would be managed to include the application of minimum requirement suppression techniques, the consideration of firefighter and public safety, a cost/benefit analysis sensitive to natural and cultural resources, and the strategic and tactical options described in an approved fire management plan. Further, fire management plans must address the effects of fire management decisions on wilderness resources and character, air quality, smoke management, water quality, and other pertinent natural and cultural resource management objectives. Until a fire management plan is approved, all wildland fires in wilderness must be suppressed.

Given the proximity of the Philip Burton Wilderness Area to developed areas and the potential for a wildland fire to spread beyond park boundaries, fire management planning at PRNS puts special emphasis on suppression of wildland fire in wilderness. According to Director's Order 41, if a wildland fire requires Point Reyes management to delegate fire-fighting authority, park personnel would first inform them of the appropriate emphasis on the protection of wilderness resources. The methods used to suppress all wildland fires should be those that minimize the impacts of the suppression action and the fire itself, commensurate with effective control and the preservation of wilderness values.

Fire suppression actions in the wilderness would be directed by minimum requirement strategies geared to avoid resource impacts to the greatest extent feasible given the severity of the wildland fire. Information on the location of sensitive plant and wildlife habitats, cultural resources, wetlands, and creeks would be used to direct the construction of fire lines, siting of staging areas, water intake, and other potential impacting actions. Fire suppression teams at the park are trained in the concepts of wilderness fire management and minimum tool use. These techniques would be implemented to the extent feasible to control wildland fire and protect life and property.

Current Activities in Wilderness. NPS activities in the Philip Burton Wilderness are restricted to those necessary to allow for safe recreational use of the area. Non-wilderness fire road corridors allow maintenance staff motorized vehicle access to clean the four backcountry campsites. Wilderness trails are brushed back every two to three years using hand tools to allow enough clearance for safe passage by recreational users. Special projects are implemented as needed and in conformance with minimum requirements assessments. For example, a bridge may be replaced on a hiking trail when needed for public safety and to prevent off-trail use and disturbance. Each project is assessed individually for potential effects on the environment and wilderness setting by an interdisciplinary team of park staff and in accordance with NEPA, the Endangered Species Act, the Wilderness Act, and NPS policies. Table 36 shows which of the

FMUs contain lands that are designated federal wilderness, how many acres of wilderness are included in each of these FMUs, and what percent of the FMU is federal wilderness.

Table 36. Federal Wilderness in the Fire Management Units

FMUs within the Federal Wilderness	Total Acres in FMU	Wilderness Area Acreage	
		Acres of Wilderness in the FMU	% of FMU in Wilderness
Tomales Point	2,783 acres	2,746 acres	98.6%
Headlands	881 acres	245 acres	28%
Limantour	4,144 acres	2,518 acres	61%
Wilderness North	1,591 acres	1,336 acres	84%
Wilderness South	2,298 acres	1,480 acres	64%
Highway 1	2,868 acres	67 acres	2%
Palomarin	2,022 acres	843 acres	42%

Source: Point Reyes National Seashore, GIS.

Public Health and Safety

The 2001 Federal Fire Policy sets the protection of human life as the first priority for federal wildland fire management; all federal Fire Management Plans and activities must reflect this commitment (Interagency Working Group, 2001). This is the reflected in the primary objective of the Point Reyes FMP - to protect firefighters and the public. Related FMP objectives are to protect private and public property, foster and maintain effective community and interagency fire management partnerships, and foster a high degree of understanding of fire and fuels management among park employees, neighbors, and visitors.

The Federal Fire Policy is being implemented through the National Fire Plan, which recognizes that effective fire management requires close coordination of federal agencies with local communities, particularly those communities that are in the wildland-urban interface. As the management of private lands has become a key factor in the fire-risk equation, the federal government has recognized the importance of providing outreach, education, and support for local communities who play a primary role in reducing fire hazards in and near their communities.

As part of the data gathering process in support of the National Fire Plan, the federal government identified key communities nationwide at risk from wildfire due to their proximity to federal lands managed by the Departments of Agriculture and Interior. An extensive listing was published in the Federal Register (Vol. 66, #160, Friday, 8/17/01) and included Inverness, Bolinas, and Olema, as well as communities near Point Reyes National Seashore. In recognition of potential risk, the National Park Service, through the Wildland Urban Interface Program, has been funding fire education, fuel reduction, and roadway improvement projects in these communities; 2002 is the third year of local National Fire Plan funding.

Prioritization of projects needed in the wildland urban interface has been informed by a study of strategies for rehabilitating the resources in the Vision Fire burn area and preventing similar occurrences in the future. Prepared for the Environmental Action Committee of West Marin, "After the Vision Fire," prepared by the Phoenix Team, documented many of the projects that have subsequently been funded and implemented on private and federal lands with Wildland Urban Interface funding.

Like the National Fire Plan, the EAC Phoenix Report (1996) recognizes that the most fundamental line of defense to increase public safety is to promote conformance with code requirements for defensible space and reduced fuels around homes and along streets providing emergency ingress and egress. No amount of fuel reduction on federal lands can compensate for the hazards presented by high fuel loading on private lots. Many of the fire education, community chipper programs, safety assessments, and roadway improvement projects funded by the NPS have focused facilitating code conformance on private property.

In the first two years of Wildland Urban Interface (WUI) funding, projects in the interface with PRNS focused on public health and safety by:

- Improving the safety of subdivision roads that would be used as evacuation routes by residents and for ingress and egress by emergency responders,

- Providing assessments for individual homeowners on safety deficits on their properties,

- Providing chipper days in several communities to facilitate disposal of vegetation cleared from private lots, and

- The dissemination of fire education materials promoting defensible space concepts.

In the Inverness/Inverness Park area, over 16 miles of subdivision roads, have had roadside vegetation brush cut or thinned to reduce fuels, overhanging branches limbed up to provide overhead vehicle clearance for emergency vehicles, trees presenting treefall hazard removed, and pullouts and turnarounds either re-established or constructed. Fire hazard assessments were completed for the Seahaven and Paradise Ranch Estates subdivisions with each private parcel rated under four safety categories. This information is provided to the homeowner to help them understand the relative hazard presented by the condition of their parcel and help the homeowner focus their efforts in productive directions.

The next round of WUI funded projects focus on creating shaded fuel breaks between open space lands and residential areas in addition to continued chipper days, further education materials, and a hazard assessment program for Bolinas. The fuel breaks would serve as zones of reduced fuel to slow the progress of wildland fires, provide firefighters with an area from which to launch suppression actions, and provide alternate evacuation routes to residents. The proposed fuel break would cross state park, national park, and private-held lands.

The FMP alternatives demonstrate a clear focus on reducing risk to neighboring communities by identifying project areas on the federal side of the interface that complement the WUI projects on private and state-owned lands. FMP projects in the Inverness Ridge, Limantour, Palomarin, and Olema FMUs would improve safety to responding firefighters, reduce fuels along existing fire roads, and create zones of reduced fuels to impede fire spread.

Following the completion of the EIS process, the park will select one alternative to become the FMP. It will be a procedural document outlining response, suppression, and proactive strategies for managing fire in PRNS. The FMP would be implemented by the Point Reyes Fire Management Office staff led by the Fire Management Officer under the direction of the Superintendent, a program analyst, a hazardous fuels specialist, a 10-person hazard fuels crew, and 1-2 engine technicians. The Fire Management Office staff and equipment has been housed in the southern portion of the Peninsula. As part of the current FMP EIS, PRNS is proposing to move the Fire Management Office to a new fire cache building at the central area of the park in Bear Valley (for further description see Alternatives, Actions Common to All Alternatives). The move would improve communication, response time, and facilitate coordinated efforts with the local fire departments in Inverness and Point Reyes Station.

The principal effect of FMP activities on public health is generation of smoke, especially particulate matter, from prescribed fires and unintended wildland fire. Particulate matter, found in the air-liquid droplets and small solid particles of minerals and soot can penetrate deep into the lungs. In smoke, roughly 80% of the particulate matter is smaller than 2.5 micrometers in diameter.

Healthy adults are not usually at risk from particulate matter; they may experience runny noses and coughing but these symptoms usually subside as the smoke disperses. People with heart or lung diseases, such as congestive heart disease, chronic obstructive pulmonary disease, emphysema or asthma, can be at risk. People with these conditions may find it difficult to breathe, may cough or feel short of breath. Children and the elderly are generally more susceptible to the harmful effects of smoke (CARB, 2003).

Baseline air quality information is found in this chapter under the heading of Air Quality. The Bay Area Air Quality Management District (BAAQMD) in accordance with the California Smoke Management Guidelines manages the generation of smoke by prescribed burning. The goal of smoke management guidelines is to continue prescribed burning as a resource management tool while minimizing smoke impacts to public health in populated areas.

Socio-Economics

PRNS is one of the 30 most visited parks in the National Park System. It is a destination park for national and international visitors, as well as a regularly visited resource for the 5 million residents of the 9 counties that comprise the greater San Francisco Bay Area. Visitation to the park is approximately 2.5 million annually and unusually is consistent year round, averaging roughly 200,000 visitors monthly.

Marin County has a $500 million annual tourist industry. It is estimated that PRNS contributes over $150 million to the regional economy visitor expenditures on dining, fuel, gifts, groceries, and lodging (NPS, 2002a). According to a visitor survey conducted by Sonoma State University (1997), 74% of the visitors to Point Reyes National Seashore are traveling to the Seashore as their main destination, 50% of park visitors are staying between 2-6 hours in the park (30%

overnight), and 40% of visitation comes from Marin, Sonoma, and San Francisco Counties (16.5% come from outside of California).

Point Reyes National Seashore received 2.35 million visitors in 2000 accounting for 930 travel party days/nights in the area. An average visitor party spends $94 per party per night in the local area ($109 if locals excluded). Total visitor spending was $87 million in 2000, $80 million excluding local visitors. This spending of visitors from outside the local region generates $69 million in sales by local tourism businesses, yielding $25.6 million in direct income and supporting 1,100 jobs. Each dollar of tourism spending yields another $.63 in sales through the circulation of spending within the local economy. Including these secondary effects, the total economic impact of the park on the local economy is $113 million in sales, $42 million in wages and salaries, and 1,800 jobs (Michigan State University, 2001).

The park has not received complaints from visitors during past prescribed fires in the park (pers. comm. Neubacher, 2003). Park visitation dropped dramatically for the first few months after the 1995 Vision Fire, but returned to normal within six months.

CHAPTER 4: ENVIRONMENTAL CONSEQUENCES

INTRODUCTION

This chapter provides a detailed analysis and discussion of the probable environmental consequences, or impacts, of implementing each of the three alternatives. The chapter begins with a discussion of methods used to conduct the environmental impact assessment, including general definitions related to the impact analysis. These are followed by a description of the methods used to assess impacts for each impact topic (e.g., air quality, water quality, etc.), including relevant policies, regulations, and assumptions.

Following the sections on impact assessment methodology, the environmental impacts related to each impact topic for Alternatives A, B, and C are comprehensively addressed.

The analysis for each impact topic includes the following:

- Identification of the types of impacts associated with the various actions comprising the alternative;
- Characterization of the impacts, including their duration and intensity;
- Available mitigation measures that would be applied and the effectiveness of these measures on reducing impacts;
- An assessment of cumulative impacts;
- A statement on the potential for implementation of an alternative to impair resources (based on the National Park Service policy on impairment); and
- A conclusion (Conclusions will be the last subsection).

With the exception of the cultural resource analysis, all impacts have been assessed assuming that the mitigation measures that are discussed would be implemented. Cultural resource impact analysis in this EIS is described in terminology consistent with the regulations of the Council on Environmental Quality (CEQ) and will comply with requirements of both the NEPA and Section 106 of the NHPA. The determination of effect for the undertaking (implementation of the alternative) required by the National Park Service Agreement is included in the “conclusion” section of each alternative.

DEFINITION OF TERMS

Three separate aspects of impacts are described for each impact topic for each alternative: the type of impact, the duration of impact, and the intensity of impact. For purposes of this analysis, these aspects are defined as follows:

Type of impact - The type of impact describes the specific elements that could be subject to impacts and the nature of those impacts. Impacts can be either beneficial or adverse.

Duration of impact - The duration of impact describes the relative length of time the impact would affect a given resource. Impacts can be either short-term or long-term, and are defined for each impact topic in a range of years. It is important to note that an action that has short-term adverse effects on a resource may have long-term beneficial impacts on the same resource.

Intensity of Impact - Identifies the degree to which a resource would be affected by an element of an alternative. Each impact is described as negligible, minor, moderate, or major. These four designations are used for beneficial as well as adverse impacts.

NEPA requires consideration of the direct, indirect, and cumulative impacts of proposed actions. The CEQ regulations (Section 1508.7) define a cumulative impact as “the impact on the environment which results from the incremental impact of the action when added to other past, present, and reasonably foreseeable future actions regardless of what agency (federal or non-federal) or person undertakes such other actions.” Cumulative impacts can result from individually minor but collectively significant actions taking place over a period of time. “Reasonably foreseeable future actions” include planning or development activities that currently are being implemented or would be implemented in the reasonably foreseeable future.

A list of actions that could contribute to cumulative impacts is provided in Appendix C. In the cumulative impact analyses in this EIS, the impacts of these actions are assessed in conjunction with the impacts of each alternative for each impact topic.

In the conclusion section is a statement regarding whether or not implementing the alternative would cause resource impairment. The NPS Organic Act of 1916 and the NPS General Authorities Act 1970, as amended, require park managers to ensure that park resources and park values remain unimpaired. Section 1.4.5 of the NPS Management Policies (NPS, 2000) states: “The impairment that is prohibited by the Organic Act and the General Authorities Act is an impact that, in the professional judgment of the responsible NPS manager, would harm the integrity of park resources or values, including the opportunities that otherwise would be present for the enjoyment of those resources or values.”

The Management Policies further state, “An impact to any park resource or value may constitute an impairment. An impact would be more likely to constitute an impairment to the extent that it affects a resource or value whose conservation is:

- Necessary to fulfill specific purposes identified in the establishing legislation or proclamation of the park;
- Key to the natural or cultural integrity of the park or to opportunities for enjoyment of the park; or
- Identified as a goal in the park’s general management plan or other relevant NPS planning documents.

An impact would be less likely to constitute an impairment to the extent that it is an unavoidable result, which cannot reasonably be further mitigated, of an action necessary to preserve or restore the integrity of park resources or values.”

REGULATIONS AND METHODOLOGY BY IMPACT TOPIC

Applicable regulations, policies, and methods used to assess the environmental consequences of the three alternatives on the following impact topics are described in the succeeding sections:

- Soils
- Air Quality
- Water Resources and Water Quality
- Vegetation
- Wetlands
- Wildlife
- Special Status Species (e.g., Threatened, Endangered, Rare and Sensitive Species)
- Cultural Resources
- Visitor Use and Visitor Experience
- Park Operations
- Public Health and Safety
- Socioeconomics

Soils

Policies and Regulations

As directed by NPS Management Policies, soil resources are subject to the "no impairment" clause that guides NPS decision-making to protect of the integrity of the important resources and values within the parks (NPS, 2000, §1.4.6). The NPS is directed to protect geologic features from the adverse effects of human activity, while allowing natural processes to continue (NPS, 2000, §4.1.5 and §4.8.2). Management action taken by the parks would prevent to the greatest extent possible the unnatural erosion, physical removal, contamination, and other potentially irreversible impacts to soil (NPS, 2000, §4.8.2.4).

Hydric soils, associated with wetland features such as bogs, marshes, and some wetlands, are afforded special protection by Executive Order 11990, Protection of Wetlands and the Clean Water Act Section 404 as regulated by the U.S. Army Corps of Engineers, and the State Regional Water Quality Control Board. Specific procedural guidance to NPS staff on the protection of wetlands and areas of hydric soils is outlined in Director's Orders 77-1, Wetland Protection. Assessment of potential FMP impacts to hydric soils is addressed as a water quality impact in this document.

The NPS Natural Resource Management Guidelines (Director's Order 77) contain objectives for the protection of soils in the four natural resource management zones used in NPS planning:

Assessment Methodology

The discussion of potential impacts to soils from implementation of the FMP alternatives will address degradation or depletion of soil resources. Sedimentation of creeks and water bodies is addressed under the heading of hydrology/water quality.

Determination of Effect. The primary source for information on Seashore soils is the 1979 Soil Conservation Service Soil Survey of Marin County. With few exceptions, limited information exists on specific baseline biotic, chemical, and compositional condition of the numerous soil units in the park beyond the generalized information provided in the Soil Survey. In this respect, the determination of effect on soils is based on both direct effects to soil resources and inferred from the observation of indirect effects manifested by a change in the vigor of the vegetation supported by soils or a change in the rate of sedimentation in runoff reaching creeks and ponds.

The determination of the degree of impact on soils for the FMP was developed from the direct and repeated field experience of Seashore staff and/or the conservative application of generally accepted research findings on the effects that fire management actions have on soil. These include the reaction of soil resources to both well-established routine activities, such as mechanical clearing and controlled burning, and to non-routine fire suppression actions that vary greatly depending on the specific challenges of each occurrence.

Long-term impacts to soils including changes to soil chemistry, creation of subsurface hydrophobic layers, changes in soil particle composition or mixing, or loss of the soil profile may take years or decades to recover. Short-term impacts are defined as effects to soil processes that are abated through natural processes or aided by use of standard protective practices within four years of the action. Soil productivity and slope stability is regained within this time period. The first winter season following the Vision Fire, runoff and erosion increased in the granitic soils of the Inverness Ridge due to increased hydrophobicity (water repellency) and an overlying crust–like layer. These characteristics diminished following the second year post-fire. Accelerated cutting of stream channels slowed markedly within three years post-fire (B. Ketcham, pers. comm).

Actions with negligible impact are those that are either inherently benign or with effects mitigated to a less than detectable level by the procedural standards, such as erosion control practices, implemented as part of the proposal. Actions with minor impacts would be limited in scope and effect to soils. For example, a low intensity prescribed fire may have several limited affects on soils such as a short-term reduction in protective vegetation cover and consequent slight increase in the rate of soil erosion in an area remote from sensitive water resources.

It is important to assess impacts to soil resources on a system and process level. Watershed scale allows consideration of soil loss and deposition to downstream water resources. Prescribed burns would also likely be designed within a watershed to avoid inclusion of higher, steeper slopes between two watersheds. A stable watershed requires 30% to 50% effective soil cover (ESC) (BAER, 1996). The Forest Service considers a watershed with more than 75% effective ground cover to be in good hydrologic condition wherein only about 2 percent or less of rainfall becomes surface runoff, and erosion is low (Robichaud et. al., 2000).

Effective soil cover includes larger rock fragments, thick leaf litter, plant cover, and mat-forming vegetation in contact with the soil surface. As a conservative threshold with high confidence, impacts to soils within a watershed are deemed minor if FMP actions affect less than 10% of an FMP watershed.

A moderate impact results when more than 10% and less than 25% of the effective soil cover in an FMP watershed is disturbed in one year with impacts to soil resources that are readily correctable by the application of standard erosion control practices. Examples could include a prescribed fire in terrain that gradually slopes that requires erosion control only in limited areas that are oversteepened. Moderate impacts could also result from a wildland fire greater than 10% of a watershed or that required limited use of heavy equipment but burned at a relatively low intensity with little effect on overall soil properties.

Major impacts to soil resources are those that substantially change soil processes or vital soil characteristics in widespread areas of one or more resource watersheds and may trigger related important effects to other park resources such as plants, wildlife, visitor experience, or cultural resource sites. Major impacts to soil resources also include prescribed fire or wildland fire affecting more than 25% of a resource watershed in one year.

Type of Impact

Beneficial: Protects or enhances properties of native soils and promotes or restores natural soil processes.

Adverse: Degrades the characteristics of native soils, exposes soils to accelerated rates of erosion, results in loss of native soils, or contributes to slope failure.

Duration of Impact

Short-term: Impacts are limited to the first four years after treatment or wildland fire.

Long-term Impacts persist four years after treatment or wildland fire.

Intensity of Impact

Negligible: No quantifiable impact and/or reasonably anticipated type of effect based on current knowledge of soil characteristics.

Minor: Fire management actions or incidents of wildland fire confined to plots comprising less than 10% of the total area of an FMP resource watershed wherein rate of post-action erosion can be controlled by standard practices; there is low potential for changes to soil productivity.

Moderate: Fire management actions or wildland fires affecting more than 10% and less than 25% of the total area of an FMP watershed wherein the rate of post-action erosion would be controlled by the application of standard erosion control practices, and little change in soil productivity.

Major: Fire management actions or wildland fires affecting more than 25% of the total area in an FMP watershed or more than 10% of total area of the watershed with impacts that reduce soil productivity or produce rates of erosion that are not readily correctable by best management practices.

Air Quality

Background. Similar to many other national parks near urban areas, the response to wildland fire in the PRNS has been full suppression. One of the results of suppression is the build up of areas of high fuel loading within the park that has increased the potential for a high intensity wildland fire to occur. The events of October 3 – 8, 1995, when the Vision Fire burned 12,354 acres provide a dramatic example of that potential. To address the existing hazard, the fire management program at PRNS has been conducting prescribed burns on several hundred acres within the park each year to reduce fuels in critical areas.

Prescribed burning, proposed in the FMP alternatives, would continue this reduction of high fuel loading within the project area. Continued fuel reduction at key locations would reduce the potential for a large, uncontrollable fire that could generate substantial air pollution emissions and impact regional air quality. As required by the Clean Air Act regional haze provisions, all prescribed fires would continue to be planned and implemented within the Bay Area Air Quality Management District's (BAAQMD) Smoke Management Program.

The air quality assessment will evaluate the potential impacts of pollutants generated by the maximum allowable acreage that can be treated by prescribed burning and mechanical treatment for each FMP alternatives.

Policies and Regulations

National Ambient Air Quality Standards. PRNS is classified as a Class I area under the Clean Air Act (42 USC 7401 et seq.). The Act requires land managers of Class I areas to protect air quality and related values, including visibility, plants, animals, soils, water quality, cultural and historic structures, and visitor health from the effects of air pollution. Values must be protected from any future impairment and remedies sought for any existing impairment from human-caused sources of air pollution. A cooperative program, the Interagency Monitoring of Protected Visual Environments (IMPROVE), between the EPA, federal land managers, and state air agencies, was formed to monitor visibility in the Class I areas.

Data published in a recent IMPROVE report shows that visibility at PRNS improved during the period of 1996 to 1999 primarily due to a decrease in nitrate particulates, a major component of visibility blocking material in coastal California. Particulate nitrate is formed from nitrogen oxide and hydrocarbon gases emitted into the atmosphere from fires, diesel engines, and other sources (Malm, 2000). Monitoring by the NPS found no exceedances for ozone at PRNS under either the California or federal standard. The park air resources are rated as having low exposure to ozone, sulfur, and nitrogen emissions and low potential for acidification of surface waters. A recent NPS report states, "There are no significant air pollution effects concerns in this park [PRNS] at the present time" (Sullivan, et.al., 2001).

The Clean Air Act (CAA) charges the Environmental Protection Agency (EPA) with identifying national ambient air quality standards to protect public health and welfare. Standards have been set for seven pollutants: ozone (O_3), carbon monoxide (CO), nitrogen dioxide (NO_2), sulfur dioxide (SO_2), particulate matter less than 10 microns (PM_{10}), very fine particulate matter less than 2.5 microns in diameter ($PM_{2.5}$), and lead (Pb). Section 176 of the Act requires federal actions to conform to state implementation plans for achieving and maintaining the air quality standards. Federal actions cannot cause or contribute to new violations, increase the frequency or severity of any existing violation, interfere with timely attainment or maintenance of a standard, delay emission reduction milestones, or contradict the State Implementation Plan. The conformity rule applies to federal non-attainment areas, such as the Bay Area Air Basin. If a standard is exceeded more than three times in three years in an air basin it is considered a non-attainment area and is then be subject to more stringent planning and pollution control requirements. Table 37 presents the current federal and California ambient air quality standards.

Table 37. Ambient Air Quality Standards & Bay Area Attainment Status

Pollutant	Averaging Time	California Standards[1]		National Standards[2]	
		Concentration	Attainment Status	Concentration[3]	Attainment Status
Ozone (O^3)	8 Hour			0.08 ppm	N
	1 Hour	0.09 ppm (180 $\mu g/m^3$)	N	0.12 ppm (235$\mu g/m^3$)	N[4]
Carbon Monoxide (CO)	8 Hour	9.0 ppm (10 mg/m^3)	A	9 ppm (10 mg/m^3)	A[5]
	1 Hour	20 ppm (23 mg/m^3)	A	35 ppm (40 mg/m^3)	A
Nitrogen Dioxide (NO_2)	Annual Average			0.053 ppm (100 $\mu g/m^3$)	A
	1 Hour	0.25 ppm (470 $\mu g/m^3$)	A		
Sulfur Dioxide (SO_2)	Annual Average			80 $\mu g/m^3$ (0.03 ppm)	A
	24 Hour	0.04 ppm (105 $\mu g/m^3$)	A	365 $\mu g/m^3$ (0.14 ppm)	A
	1 Hour	0.25 ppm (655 $\mu g/m^3$)	A		
Particulate Matter (PM_{10})	Annual Arithmetic Mean	20 $\mu g/m^3$	N[6]	50 $\mu g/m^3$	A
	24 Hour	50 $\mu g/m^3$	N	150 $\mu g/m^3$	U
Particulate Matter - Fine ($PM_{2.5}$)	Annual Arithmetic Mean	12 $\mu g/m^3$	N[6]	15 $\mu g/m^3$	U
	24 Hour			65 $\mu g/m^3$	U
Sulfates	24 Hour	25 $\mu g/m^3$	A		
Lead (Pb)	Calendar Quarter			1.5 $\mu g/m^3$	A
	30 Day Average	1.5 $\mu g/m^3$	A		
Hydrogen Sulfide	1 Hour	0.03 ppm (42 $\mu g/m^3$)	U		
Vinyl Chloride (chloroethene)	24 Hour	0.010 ppm (26 $\mu g/m^3$)	No information available		

Visibility Reducing particles	8 Hour (1000 to 1800 PST)	(See note 7)	A	

A=Attainment N=Nonattainment U=Unclassified

ppm=parts per million mg/m3=milligrams per cubic meter µg/m3=micrograms per cubic meter

[1] California standards for ozone, carbon monoxide (except Lake Tahoe), sulfur dioxide (1-hour and 24-hour), nitrogen dioxide, suspended particulate matter - PM_{10}, and visibility reducing particles are values that are not to be exceeded. The standards for sulfates, Lake Tahoe carbon monoxide, lead, hydrogen sulfide, and vinyl chloride are not to be equaled or exceeded. If the standard is for a 1-hour, 8-hour or 24-hour average (i.e., all standards except for lead and the PM_{10} annual standard), then some measurements may be excluded. In particular, measurements are excluded that ARB determines would occur less than once per year on the average. The Lake Tahoe CO standard is 6.0 ppm, a level one-half the national standard and two-thirds the state standard.

[2.] National standards other than for ozone, particulates and those based on annual averages are not to be exceeded more than once a year. The 1-hour ozone standard is attained if, during the most recent three-year period, the average number of days per year with maximum hourly concentrations above the standard is equal to or less than one. The 8-hour ozone standard is attained when the 3-year average of the 4th highest daily concentrations is 0.08 ppm or less. The 24-hour PM_{10} standard is attained when the 3-year average of the 99th percentile of monitored concentrations is less than 150 µg/m3. The 24-hour $PM_{2.5}$ standard is attained when the 3-year average of 98th percentiles is less than 65 $\mu g/m^3$.

Except for the national particulate standards, annual standards are met if the annual average falls below the standard at every site. The national annual particulate standard for PM_{10} is met if the 3-year average falls below the standard at every site. The annual $PM_{2.5}$ standard is met if the 3-year average of annual averages spatially-averaged across officially designed clusters of sites falls below the standard.

[3.] National air quality standards are set at levels determined to be protective of public health with an adequate margin of safety. Each state must attain these standards no later than three years after that state's implementation plan is approved by the Environmental Protection Agency.

[4.] In August 1998, the Bay Area was redesignated to nonattainment-unclassified for the national 1-hour ozone standard.

[5.] In April 1998, the Bay Area was redesignated to attainment for the national 8-hour carbon monoxide standard.

[6.] In June 2002, CARB established new annual standards for $PM_{2.5}$ and PM_{10}.

[7.] Statewide VRP Standard (except Lake Tahoe Air Basin): Particles in sufficient amount to produce an extinction coefficient of 0.23 per kilometer when the relative humidity is less than 70 percent. This standard is intended to limit the frequency and severity of visibility impairment due to regional haze and is equivalent to a 10-mile nominal visual range.

Source: http://www.baaqmd.gov/pln/ambientairquality.asp. Updated January 2003.

The EPA has developed regional haze regulations to improve visibility or visual air quality in national parks and wilderness areas across the country (EPA, 1999). In developing these rules, the EPA recognized that both prescribed and wildland fires contribute to regional haze; that there is a complex relationship between what is considered a natural source of fire versus a human-caused source of fire. In many instances, the purpose of prescribed fires is to restore the natural fire regime to forest ecosystems to prevent future catastrophic fires that can detrimentally affect air basin air quality. The EPA works to support state and federal land managers in the development of enhanced smoke management plans to minimize the effects of fire emissions from prescribed fires on pubic health and welfare.

California Ambient Air Quality Standards. The Federal Government has ceded responsibility and authority to establish air quality standards and regulations to the States. Therefore all NPS areas are required to comply with state laws on these matters regardless of the type of legal jurisdiction that applies to other activities within the NPS unit.

To protect public health and welfare, the California Air Resources Board (CARB) has set stricter ambient air quality standards than national standards. Under the 1988 California Clean Air Act, air basins were designated as attainment, non-attainment, or unclassified for the state standards.

State implementation plans identify measures designed to bring non-attainment areas into attainment. Basic components of state implementation plans include legal authority, an emissions inventory, an air quality monitoring network, control strategy demonstration modeling, emission limiting regulations, new source review provisions, enforcement and surveillance strategies, and other programs necessary to attain standards.

The CARB is responsible for disseminating regulations about air quality, including state ambient air quality standards and area designations, emissions from motor vehicles, fuels and consumer products, and airborne toxic control measures. Title 17 of the California Code of Regulations, titled Smoke Management Guidelines for Agricultural and Prescribed Burning, provides direction to air pollution control and air quality management districts for the regulation and control of agricultural burning, which includes prescribed burning. The guidelines are intended to allow the use of prescribed burning as a management tool, while minimizing smoke impacts on the public.

San Francisco Bay Area Air Quality Management District (BAAQMD*)*. BAAQMD is the air quality management district for the project area and has primary responsibility for control of air pollution from prescribed burning. BAAQMD has procedures that must be followed prior to implementation of a prescribed burn plan. For all prescribed fires, BAAQMD requires submission of the individual burn plan at least one month prior to the proposed burn. BAAQMD then issues a forecast 72-hours prior to the proposed date and gives a final commitment to permit the burn on the day of the burn itself, though forecasts with increasing confidence can be obtained at 96-hours, 72-hours, 48-hours, and 24-hours prior to the burn day to support moving forward on all the logistical planning needed to conduct a prescribed burn.

National Park Service Guidance and Policies. NPS Management Policies direct superintendents to comply with all federal, state, and local air quality regulations and permitting requirements when conducting prescribed burns (NPS, 2000, §4.7.1.). In addition to the requirements of the CAA, specific guidance has been developed by the EPA to address prescribed burning. These are supplemented by guidance and policies such as the Federal Wildland Fire Management Policy and the EPA's Interim Air Quality Policy on Wildland and Prescribed Fires. These policies direct federal agencies to consider ambient air quality below the national ambient air quality standards for $PM_{2.5}$ and PM_{10} as the principal indicator of adverse impacts to public health. Poor visibility is used as the principal indicator of adverse impact to public welfare. The Natural Events Policy addresses public health impacts from wildland fires.

An objective of CARB and NPS directives is to minimize smoke impacts on people and on sensitive receptors in and near national parks. Sensitive receptors can include towns, villages, hospitals, schools, nursing homes, campgrounds, trails, scenic vistas, and Class I areas such as

PRNS. Selection of sensitive receptors is based on guidance from the California Code of Regulations Title 17, Smoke Management Guidelines for Agricultural and Prescribed Burning, and through consideration of the local setting including demographics, wind patterns, and local climatic conditions.

NPS-77 (Natural Resource Management Guidelines) states: "The National Park Service will seek to perpetuate the best possible air quality in parks because of its critical importance to visitor enjoyment, human health, scenic vistas, and the preservation of natural systems and cultural resources. The Park Service will assume an aggressive role in promoting and pursuing measures to safeguard [air quality related values] from the adverse impacts of air pollution. In cases of doubt as to the impacts of existing or potential air pollution on park resources, the Park Service will err on the side of protecting air quality and related values for future generations."

Assessment Methodology

Fire management actions could affect air quality in the project area through smoke emissions from wildland and prescribed fires, and from exhaust generated by machinery used in site preparation for prescribed burns, mechanical fuel reduction projects and suppression activities.

Method of Estimating Smoke Emission. The First Order Fire Effects Model 5.0 (FOFEM) was used to generate emission factors for PM_{10}, $PM_{2.5}$, volatile organic compounds (VOC), CO (carbon monoxide), and CO_2 (carbon dioxide) for the maximum allowable fire management actions under each alternative. FOFEM is a computer-based model that provides quantitative predictions for planning prescribed fires, conducting impact assessments, and for long-range planning and policy development. FOFEM is the standard modeling program used to demonstrate conformity with applicable environmental impact rules and regulations. The model also provides fire effects information on potential tree mortality, fuel consumption, mineral soil exposure, and smoke generation (Reinhardt, 1997). The smoke module of FOFEM does not predict smoke dispersion or model the impairment of local visibility.

The FOFEM smoke module requires a number of inputs related to burn characteristics such as fuel category, cover type, fuel loading, moisture content, and percent of crown burn. For this assessment, PRNS fire management staff described representative burn parameters for each burn unit. The area of each cover type in a given prescribed burn unit was determined based on the expertise of the fire management staff draft and vegetation mapping of the project area. The burn unit cover types were then correlated with the Society for American Foresters (SAF)/Society for Range Management (SRM) vegetation types for use in the FOFEM model. Where a direct correlation between cover types was not possible, a surrogate SAF/SRM cover type was selected. Table 38 provides a cross-reference for cover types.

Table 38. Vegetation Cover Types Used in Air Quality Emissions Analysis

FM Vegetation Class	SAF[1]/SRM[2] Type
Valley grassland, Annual grassland	SRM 208
Ceanothus, mixed chaparral	SRM 215
Pacific Douglas-fir	SAF 229

[1]Society for American Foresters (SAF) [2]Society for Range Management (SRM)

The results of the FOFEM model were used to develop average emission factors (per acre) that are used to quantify the amount of pollutants generated by the maximum prescription burning allowed for each alternative. For a given prescribed burn unit and pollutant, the emissions were quantified by the following equation:

$$E = \sum_{c=1}^{n} EFc*Ac, \text{ where}$$

E = emissions in tons/year
Efc = emission factor for coverage c in tons/acre
Ac = area of coverage in acres

Separate FOFEM runs were used to develop emission factors for wildland fires, since these typically burn under drier conditions and consume more fuel, particularly crown and branch fuels, and produce higher emissions. PRNS staff provided burn parameters based on recent wildland fires to model these emissions.

Both the prescribed and wildland fire emission factors predicted by FOFEM are higher than similar emission factors in the EPA's Compilation of Air Pollution Emission Factors (AP-42) for the same region. However, the AP-42 derived emission factors are generalized for large regions and "can vary by as much as 50 percent with fuel and fire conditions" (EPA, 1996). Since fuel loading in many areas of PRNS may be heavier than normal due to decades of fire suppression, the emission factors used here can be considered better represent PRNS conditions.

FOFEM does not provide emission factors for nitrogen oxide (NOx). According to EPA AP-42, the emission factors for NOx from wildland and prescribed fires are approximately 35 times less than those for CO emissions. Therefore, the CO emission factors produced by the FOFEM model were scaled down proportionately to estimate NOx emission factors. Table 39 provides the emission factors used for each fire type.

Table 39. Smoke Emission Factors by Fire Type

Fire type	Ecosystem	PM_{10}	$PM_{2.5}$	VOC (CH_4)	CO	NOx
		EMISSION FACTOR (LBS/ACRE)[1]				
Prescribed Fire	grass[2]	11	9	3	23	1
	brush[3]	190	161	49	404	12
Understory Fire	forest[4]	5,046	4,276	2,595	56,899	1,626
Low Intensity	grass[2]	11	9	3	23	1
Wildfire	brush[3]	190	161	49	404	12
	forest[4]	3,430	2,907	1,760	38,524	1,101
High Intensity	grass[2]	11	9	3	23	1
Wildfire	brush[3]	190	161	49	404	12
	forest[4]	5,108	4,329	2,622	57,419	1,641

Notes
1. PM_{10} = Suspended Particulate Matter, $PM_{2.5}$ = Fine Particulate Matter, CH_4 = Methane , CO = Carbon Monoxide, NOx = Nitrogen Oxides
2. Grass = SRM 208 vegetation areas
3. Brush = SRM 215 vegetation areas
4. Forest = SAF 229 vegetation areas

Annual inputs for wildland fire is based on 30 acres burned per year during 3 to 5 fire starts, a conservative estimate of wildland fire in the PRNS according to the PORE Fire Management Officer (pers. comm. Roger Wong, 7/29/03). The wildfire acreage is split up as 20 acres of grassland, 8 acres of shrubland, and 2 forested acres. The low incidence and limited acreage of wildland fire annually in the study area is due primarily to a very low incidence of deliberate fire starts on the part of the public and the wetter than usual summertime conditions of western Marin. The 30-acres of wildfire is consistent throughout the alternatives. Therefore, the difference in estimated annual emissions in the three alternatives is based on the maximum allowable prescribed fire under each.

<u>Emissions Modeling for Each Alternative</u>. The results of the FOFEM representative burn analyses were interpreted to estimate the annual air pollutant emissions for each alternative, and also to estimate the emissions for the cumulative impact scenario under each alternative. To provide comparisons of the emissions under each alternative, the FOFEM model simulations was used to estimate the annual average emissions, and cumulative impact emissions from a conceivable catastrophic fire on the order of the 1995 Vision Fire.

Conditions in the study area are such that the potential exists for the recurrence of a large, quick burning fire such as the Mt. Vision Fire of October 1995. Research into fire history in the park finds an absence of fire in lake sediments representing the last century. The fire interval in the Douglas-fir forests before suppression may have been every 7 to 15 years. As the potential exists in the project area for the reoccurrence of a large-scale wildfire, the acreage and burn regime of the 1995 Vision Fire (12,354 acres) is used as the basis from which to judge cumulative effects. The cumulative scenario for air quality impacts consists of annual project impacts plus the emissions generated by other reasonably foreseeable projects or events, such as a catastrophic fire, and the continuation of WUI projects in the communities adjacent to the project area.

If an increased level of prescribed burning and mechanical treatment is implemented, as considered under each of the action alternatives, there would be a transition period while the new fuel reduction program is being implemented, during which the annual emissions would increase due to increased prescribed burning. As more and more fuels are treated, the potential for a catastrophic fire with associated significant emissions gradually decreases as the risk declines with more and more pro-active vegetation treatment each year. That transition period would eventually lead to the desired long-term regime, where annual emissions would remain near the current long-term average, but the chance for large wildfires would be significantly diminished. The more acreage is treated annually, the faster the desired long-term stability regime is reached.

To more accurately portray cumulative effects over the life of FMP implementation, the modeled scenario for each alternative compares average emissions generated during the transition period and emissions generated when a more natural fire regime is re-established and a more stable fire ecology is achieved. During transition, the aggregate of acreage treated results in a probable decrease in the median size of a potential wildfire. For the 1000-acre alternative (Alternative B), the cumulative effect during the transition period is based on the mid-way point of the transition – year 12 – that assumes a 5000-acre wildfire instead of a wildfire of the scale of the Vision Fire. The transition period for Alternative C, with the 2000 acres of prescribed burning, a 3500-acre wildfire is the basis of the assessment.

Emissions from Mechanical Treatments

Air pollutants would be generated during the larger fuel reduction projects and during thinning prior to understory burns and site preparation for prescribed burns. Motorized equipment used in thinning and site preparation activities could include chainsaws, mowers, skidders, and haul trucks. These types of equipment are a representative sample of the types of equipment used in PRNS. Emissions associated with the use of motorized equipment were estimated for each alternative. Table 40 shows the AP-42 factors used to calculate emissions for the alternatives.

Table 40. Emission Factors for Equipment Use in Fire Management Activities

Operating Parameters			**Emission Factor (lbs/hour)1**			
Machine Type	Fuel Type	Average HP	CO	PM	NOx	VOC
Chainsaw	Gasoline	6	3.4	0.05	0.01	1.1
Mower	Gasoline	50	30.6	0.26	0.26	0.39
Skidder	Diesel	200	4.4	0.57	3.0	0.95
Haul truck	Diesel	200	4.4	0.57	3.0	0.95

Average HP = Average horsepower, CO = Carbon Monoxide, PM = particulate matter, NOx = Nitrogen Oxides, VOC = Volatile Organic Compounds (total hydrocarbons) such as methane (CH_4).

An assessment of the emissions from all mechanical treatment activities was prepared for each alternative. Mechanical emissions were calculated on a per acre basis based upon estimates from fire program managers on activity levels for each type of equipment under each fire scenario and ecosystem. Those emissions were generally a small contribution to ambient smoke emissions being modeled at the site.

Air Quality Descriptors

Type of Effect.

Beneficial: Improves or maintains air quality while lowering the potential for significant short-term pollutant release events

Adverse: Degrades current air quality.

Duration of Effect and Cumulative Impacts. The behavior of a smoke plume from a fire, including the direction and elevation that the smoke plume moves, and resulting concentrations at ground level, is highly dependent on elevation and dynamic meteorological conditions at the time. Under prescription conditions, air quality emissions generated by prescribed burning or other fire management actions would disperse within a time frame roughly the same as the duration of the fire management action. An exception to this would be if smoke from a wildfire became trapped at low altitudes in an inversion layer that can occur in the fall or winter.

The emissions contributed annually by all actions under each alternative represent new, long-term contributions to regional haze. To achieve the goals of the PRNS FMP, the potential for a large-scale fire should be reduced or the scale of the potential fire should be reduced. The emissions contributed by the potential large-scale catastrophic fire represent the cumulative air quality scenario for the FMP assessment. The fire management plan should reduce the level of hazard of a catastrophic fire over the course of implementation of the plan. Eventually, the level of hazard would revert to a more natural fire return interval. During this period of progressively reducing cumulative effect, project implementation effects remain stable as the same amount of acreage is treated each year.

Short-term Effects on air quality last less than 3 days beyond the duration of the fire management action.

Long-term Effects on air quality persist beyond the duration of the fire management actions contributing additional pollutants to the air basin on an annual basis.

Intensity of Effect: Localized Effects of Smoke

Negligible: Smoke would be barely perceptible or detectable and affect an undeveloped area (no recreational facilities or trails, no habitable structures, etc.).

Minor: Smoke would be detectable but localized within an area of low-density development for recreational or private use, of short duration (several hours), and have no lasting effects.

Moderate: Smoke would be readily perceptible but localized in an area of low-density development, be sufficient to limit use of the area for one day or less without damage to property or lasting effect.

Major: Smoke would be readily noticeable, occur in a developed area with a potential hazard to human health or creating property damage or lasting effect.

Intensity of Effect: Regional Haze.

As defined by the federal Clean Air Act and 1977 amendments, Point Reyes is a Class I airshed where visibility – the ability to see clearly across great distances and appreciate natural landscapes - must be protected from degradation (Malm, 2000). The increase in particulate matter and certain gases are the greatest influences on impairment of airshed visibility. As Point Reyes is in closer proximity to a heavily populated area than many national parks, regional haze is a very high concern. BAAQMD has adopted a Smoke Management Program to minimize regional haze and the PRNS FMP must conform to the requirements of that Program. The assessment of the annual average effect on air quality of the FMP alternatives is based on generation of particulate matter to reflect the potential contribution of FMP actions to regional haze. [Note: Management acres are equal to the extent of the full project area for the FMP (90,000 acres). Impact intensity is calculated based on emissions per acre/90,000.]

Negligible: All FMP actions generate less than 1 lb. PM_{10} annually per acre managed does.

Minor: All FMP actions generate less than 5 lbs. PM_{10} annually per acre managed.

Moderate: All FMP actions generate less than 10 lbs. PM_{10} annually per acre managed.

Major: All FMP actions generate more than 10 lbs. PM_{10} annually per acre managed.

Cumulative Impacts, Intensity of Effect.

The intensity of cumulative impact for each alternative is assessed in comparison to the emissions that could be generated by a catastrophic fire (Vision Fire scale event) under Alternative A. This large-scale fire is modeled after the vegetation type and acreage affected by the 1995 Vision Fire. The following categories will be used to describe the intensity of the air quality impact at Year 1 and Year 10 of implementation of the FMP alternative.

Negligible: Equal or greater than emissions generated by a Vision Fire-scale wildfire event.

Minor: 5 to 20% change in emissions compared to the Vision Fire-scale fire event.

Moderate: 21 to 50% change in emissions compared to the Vision Fire-scale fire event.

Major: More than 50% change in emissions compared to the Vision Fire-scale fire event.

Water Resources and Water Quality

Policies and Regulations
The Clean Water Act requires the NPS to "comply with all Federal, State, interstate, and local requirements, administrative authority, and process and sanctions respecting the control and abatement of water pollution." The NPS Freshwater Resource Management Guidelines (found in NPS-77) requires the NPS to "maintain, rehabilitate, and perpetuate the inherent integrity of water resources and aquatic ecosystems."

NPS Management Policies 2000 states: "The Service will manage watersheds as complete hydrologic systems, and will minimize human disturbance to the natural upland processes that deliver water, sediment, and woody debris to streams. These processes include runoff, erosion, and disturbance to vegetation and soil caused by fire, insects, meteorological events, and mass movement. The Service will achieve the protection of watershed and stream features primarily by avoiding impacts to watershed and riparian vegetation, and by allowing natural fluvial processes to proceed unimpeded."

Assessment Methodology
The following three primary aspects of water resources were assessed when considering potential impacts:

- Hydrology of the project area,
- Aquatic habitat within the project area, and
- Water quality.

Hydrology refers to hydrologic processes such as flooding, erosion, deposition, and maintenance of channel patterns. Aquatic habitat refers to the attributes that support or provide habitat within stream or pond systems. Water quality refers to the suitability of surface water for beneficial use, including cold-water or warm-water aquatic wildlife habitat and recreational use. Particular consideration was given to actions with potential to affect the natural hydrology, aquatic habitat features, and surface water quality of cold-water streams.

The San Francisco Bay Regional Water Quality Control Board (RWQCB) has listed Tomales Bay and its major watersheds, Lagunitas Creek and Walker Creek, as impacted by sediment, nutrients, and pathogens under Section 303 (d) of the Clean Water Act. In addition, the RWQCB has also listed Tomales Bay and Walker Creek as impaired by mercury. The RWQCB is required by the EPA to develop and implement TMDLs for each pollutant parameter by 2010.

Specific watersheds supporting cold-water aquatic habitat include Lagunitas Creek, Olema Creek, Pine Gulch Creek, and most coastal drainages originating from Inverness Ridge.

The Arroyo Hondo and upper Haggerty Gulch watersheds provide water supply to the Bolinas Community Public Utility District, and a few park residences near the Limantour Road. These water supply diversions are permitted through the State Water Resources Control Board and are agreed to by the NPS and associated water users.

Type of Impact

Adverse: would alter natural hydrologic conditions (e.g., impede flood flows, cause unnatural erosion or deposition, etc.); degrade water quality (e.g., increase pollution or bacteria levels from recreational use); or degrade aquatic habitat.

Beneficial: would restore natural hydrologic conditions (e.g., remove impediments to flood flows, stabilize riverbanks, etc.); improve water quality (e.g., reduce non-point source pollution); or improve or maintain aquatic habitat.

Duration of Impact

Short-term: would last two years or less.

Long-term: would last longer than two years.

Note: Since full implementation of an alternative would take place over a number of years, this section considers the duration of individual actions within each alternative (e.g., mechanical treatment of a specific area) instead of full implementation of the alternative.

Intensity of Impact

Negligible: would be imperceptible or not detectable.

Minor: would be slightly perceptible, without the potential to expand if left alone; and would be localized (i.e., would occur in the immediate vicinity of an action).

Moderate: would be apparent and would have the potential to become larger.

Major: would be substantial, highly noticeable, and regional (i.e., would occur over a large area, such as the Tomales Bay watershed, or the Point Reyes National Seashore). Many water quality impacts are regional because an action could potentially affect water quality downstream.

Vegetation

Policies and Regulations

NPS Management Policies 2001 state “The National Park Service will maintain as parts of the natural ecosystems of parks all native plants and animals.” The policies go on to state that the above statement includes flowering plants, ferns, mosses, lichens, algae, fungi, and microscopic plants. The NPS is to preserve and restore the natural abundances, diversities, dynamics, distributions, habitats, and behaviors of these native species. Additionally, the NPS is to prevent the introduction of exotic (non-native) species into units of the National Park System. The policy manual NPS-77 (Natural Resource Management Guidelines) also provides general guidelines on vegetation management.

Assessment Methodology
Vegetation in the project area was digitally mapped using aerial photographs in 1999/2000. Field data on plant species composition were collected to characterize and classify plant communities delineated in the mapping effort. The classification describes the vegetation alliances and associations that occur in the study area, and was initially based on the classification system described by Sawyer and Keeler-Wolf. For purposes of this document, alliances and associations found in the project area have been grouped together into 10 broad vegetation classes that are described in Chapter 3 (Affected Environment). The alliances and associations that are grouped into a given vegetation class all share species with similar growth forms and structural attributes, thus it is assumed that they would respond similarly to treatments that would be applied under the FMP. The aerial extent of each vegetation class within each FMU was derived from the Seashore's GIS.

The primary assessment of impacts on vegetation considers potential impacts of fire management activities on all vegetation, regardless of vegetation class. This is followed by special considerations and impacts unique to individual vegetation classes. The following parameters were considered when assessing impacts on individual vegetation classes:

- fire ecology of the dominant species in the vegetation class,
- past and present fire regimes of the vegetation class,
- aerial extent and relative abundance or rarity of the vegetation class in the project area and in the region, and
- abundance and species richness of non-native plants within, or adjacent to the vegetation classes affected.

The abundance, as defined by aerial extent, of an individual vegetation class is important when considering impacts because the Seashore is mandated to protect and maintain all native plant communities. If a vegetation class is very rare in the project area or the region, such as riparian woodland, adverse impacts to the vegetation class may be more significant.

The presence and abundance of non-native (or exotic) plants in the affected vegetation classes is an important consideration as many non-native plant species are stimulated to grow and reproduce as a result of fire or other disturbance. The presence of some non-native plant species can have substantial adverse effects on native vegetation, including the following:

- they can out-compete native plants for light, nutrients, water and growing space, which, in the worst case, can lead to extinction or local extirpation of rare plant species;
- they can degrade the quality of wildlife habitat by out-competing native food sources, or altering nesting or resting habitat;
- they can disrupt the genetic integrity of native plants if crossbreeding occurs; and
- they can change fire regimes by converting habitat types (e.g., conversion of a shrub or forested landscape with little understory to one that has a continuous herbaceous layer).

Much of the information on individual vegetation classes focuses on the dominant species within the classes, and the effects of fire on these species. Information on individual plant species largely was derived from the following source: U.S. Department of Agriculture (USDA), Forest

Service, Rocky Mountain Research Station, Fire Sciences Laboratory (U.S. Department of Agriculture, 2003). Fire Effects Information System (FEIS) is available online at: http://www.fs.fed.us/database/feis/, and includes comprehensive bibliographies for each species. Frequently referenced documents also are included in the References section of this EIS.

Type, duration, and intensity of vegetation impacts are described as follows:

Type of Impact

Adverse: decreases the aerial extent or native species richness of a plant community, results in a plant community type conversion, or increases invasive non-native plant species abundance or richness.

Beneficial: increases the aerial extent or native species richness of a plant community, or decreases invasive non-native plant species abundance or richness.

Duration of Impact

Short-term: would be measurable for two years or less.

Long-term: would be measurable for longer than two years.

Intensity of Impact

Intensity of impact was determined for the various fire management activities by considering the degree to which such activities would affect the aerial extent of plant communities, or would change the abundance or species richness of native or non-native plant species within plant communities.

Negligible: would result in no measurable changes in aerial extent, or in native or non-native species richness within a plant community.

Minor: changes in aerial extent, or in native or non-native species richness within a plant community would be measurable, and would affect less than 5% of the total extent of that plant community in the project area.

Moderate: changes in aerial extent, or in native or non-native species richness within a plant community would be measurable, and would affect from 5 to 25% of the total extent of that plant community in the project area.

Major: changes in aerial extent, or in native or non-native species richness within a plant community would be measurable, and would affect 25% or more of the total extent of that plant community in the project area.

Wetlands

Policies and Regulations

Wetlands are addressed separately from other vegetation types in this impact analysis as they are protected by a specific set of laws and regulations. Wetlands are lands that are transitional between terrestrial and aquatic systems, where the water table is usually at or near the surface, or the land is covered by shallow water. Wetlands buffer the effects of hydrologic and erosional cycles, influence biogeochemical cycles of nitrogen and other key nutrients, and create unique microclimates for animal and plant species.

The protection of wetlands within NPS units is facilitated through the following:

- Executive Order 11990, Protection of Wetlands.
- NPS Director's Order 77-1, Wetland Protection and its accompanying Procedural Manual 77-1 (DO 77-1 and PM 77-1).
- Rivers and Harbors Act, Section 10.
- Clean Water Act, Section 404.
- The "no net loss" goal outlined by the White House Office on Environmental Policy in 1993.

Executive Order 11990 requires that agencies work to minimize the destruction, loss, or degradation of wetlands. Director's Order 77-1 and Procedural Manual 77-1 provide specific procedures for implementing Executive Order 11990. Section 10 of the Rivers and Harbors Act and Section 404 of the Clean Water Act authorize the U.S. Army Corps of Engineers to grant permits for construction and disposal of dredged material in waters of the United States, which includes wetlands.

Assessment Methodology

For this assessment, wetlands that could be subject to impacts were identified using National Wetlands Inventory (NWI) information (USFWS, 1984), enhanced wetland mapping data recently acquired through intensive field inventory efforts, and information from the Seashore's vegetation map (NPS, 2001). These data layers then were overlain with the boundaries of the 10 fire management units. This information provided a conservative and broad estimate of the extent of known and potential wetlands within the planning area. The approximate number of acres that would be subject to impacts was estimated using the Seashore's GIS.

The parameters that were considered in the assessment of impacts on wetlands include the following:

- plant species composition of the wetland, including abundance and species richness of invasive non-native plant species;
- hydrologic features that maintain the wetland; and
- wetland soils.

These parameters parallel those used by the Army Corps of Engineers when defining wetlands. It is assumed that if these parameters are altered as a result of fire management activities, the wetland would be subject to impacts, which could be either beneficial or adverse.

Type, duration, and intensity of wetlands impacts are described as follows:

Type of Impact

Adverse: Shifts plant species composition to a higher percentage of non-wetland indicator species; alters hydrologic features/factors that are required to maintain the wetland; alters soil properties that are required to maintain the wetland; or reduces aerial extent of wetlands.

Beneficial: Enhances wetland vegetation, soils, or hydrology, or increases aerial extent of wetlands.

Duration of Impact

Short-term: would be measurable for two years or less.

Long-term: would be measurable for longer than two years.

Intensity of Impact

Negligible: would result in no measurable changes in the aerial extent of wetlands, or in wetland vegetation, soils, or hydrology.

Minor: changes in the aerial extent, or in wetland vegetation, soils or hydrology would be measurable but would affect less than 5% of the total extent of the wetland type in the project area.

Moderate: changes in the aerial extent, or in wetland vegetation, soils or hydrology would be measurable but would affect less than 20% of the total extent of the wetland type in the project area.

Major: changes in the aerial extent, or in wetland vegetation, soils or hydrology would be measurable and would affect 20% or more of the total extent of the plant community in the project area.

Wildlife

Policies and Regulations

NPS Management Policies 2001 state: "The National Park Service will maintain as parts of the natural ecosystems of parks all native plants and animals." The policy statement includes bacteria, mammals, birds, reptiles, amphibians, fishes, arthropods, worms, and microscopic animals. The NPS is to preserve and restore the natural abundance, diversities, dynamics, distributions, habitats, and behaviors of these native species. Additionally, the NPS is to prevent the introduction of exotic (non-native) species into units of the National Park System. The policy manual NPS-77 (Natural Resource Management Guidelines) also provides general guidelines on wildlife management.

The NPS also is required to comply with the Fish and Wildlife Coordination Act; the Marine Mammal Protection Act; the Bald and Golden Eagles Protection Act; the Wilderness Act; the Convention on International Trade in Endangered Species; and maritime and other international agreements. The NPS also is required to comply with The Migratory Bird Treaty Act (1918) as amended, which prohibits taking, killing, or possessing migratory birds, nests, or eggs. As a refuge for tule elk, Point Reyes National Seashore is directed to participate in a Federal/State cooperative program for preservation and enhancement of tule elk in California under the Tule Elk Preservation Act (1976).

Assessment Methodology
Many wildlife concerns can be addressed by considering the effects of actions on wildlife habitat as represented by general vegetation types. In general, adverse effects on wildlife can be minimized by reducing and limiting habitat fragmentation; that is, by preserving and restoring large areas as well as patches of habitat, and maintaining connections within and among habitat types. Larger patches of habitat tend to support higher numbers and diversity of wildlife species than smaller ones, and connections between habitat patches enable the movement of wildlife between areas, enhancing reproduction and survival. Small patches of habitat can serve as stepping-stones for wildlife moving between larger blocks.

The value of habitat patches for wildlife is also affected by adjacent human activities and development. Severe disruption of habitat corridors can impede wildlife movements. Impacts radiating into habitat patches, such as noise, non-native species, and human use, can adversely affect habitat quality. Wildlife tend to prefer a core of habitat that is more isolated from radiating impacts.

Impacts on wildlife have been assessed in terms of the following:

- Changes in the amount and distribution of wildlife habitat;
- Changes in the size and connectivity of habitat patches; and
- The existing integrity/quality of affected habitats (including past disturbances), and the relative importance of affected habitats.

Type of Impact
Adverse: would negatively affect the size, continuity, or integrity of wildlife habitat.

Beneficial: would positively affect the size, continuity, or integrity of wildlife habitat.

Duration of Impact
Long-term: would last two years or longer.

Short-term: would be expected to last for less than two years.

Intensity of Impact
Negligible: would not be measurable or perceptible.

Minor: would be measurable or perceptible and would be localized within a relatively small area; however, the overall viability of the resource would not be affected. Without further impacts, minor adverse effects would be reversed, and the resource would recover.

Moderate: would be sufficient to cause a change in the resource (e.g., abundance, distribution, quantity, or quality); however, the impact would remain localized. The change would be measurable, but negative effects could be reversed in the long-term.

Major: would be substantial, highly noticeable, measurable, and could be irreversible (permanent). The resource would be unlikely to recover.

Special-Status Species

Policies and Regulations

Numerous species of plants and animals have undergone local, state, or national declines, which has raised concerns about their possible extinction if they are not protected. As a result, the U.S. Fish and Wildlife Service (USFWS) and the California Department of Fish and Game (CDFG) have established lists that reflect the species' status and the need for monitoring, protection, and recovery. In addition to federal and state-listed species, potential impacts on plants listed by the California Native Plant Society (CNPS) also are considered for all programs and activities that the Seashore undertakes. The Seashore also recognizes a number of species as locally rare or of special concern, even though they are not officially listed. Collectively, species in all of these categories are referred to in this document as "special-status species."

The Federal Endangered Species Act (ESA) of 1973, as amended, requires federal agencies to consult with the USFWS before taking actions that (1) could jeopardize the continued existence of any federally listed plant or animal species (e.g., listed as threatened or endangered) or species proposed for listing, or (2) could result in the destruction or adverse modification of critical or proposed critical habitat. The USFWS provided upon request a list of species that must be considered for this EIS.

The Council of Environmental Quality Regulations for Implementing the National Environmental Policy Act (Section 1508.27) also requires considering if an action may violate federal, state, or local laws or requirements imposed for the protection of the environment. For this reason, species listed under the California Endangered Species Act (i.e., those considered endangered or threatened) by the California Department of Fish and Game are included in this analysis. Species proposed for listing in either of the two categories are also included.

NPS Management Policies (NPS, 2000) state: "The National Park Service will identify and promote the conservation of all federally listed threatened, endangered, or candidate species within park boundaries and their critical habitats.... The National Park Service also will identify all state and locally listed threatened, endangered, rare, declining, sensitive, or candidate species that are native to and present in the parks, and their critical habitats.... All management actions for protection and perpetuation of special status species will be determined through the park's resource management plan."

Additionally, park managers are to ensure that park operations do not adversely impact endangered, threatened, candidate, or sensitive species and their critical habitats, within or outside the park and must consider federal and state listed species and other special-status species in all plans and NEPA documents (NPS-77 Natural Resource Management Guidelines).

NPS-77 states: “The following legislation, policies, and agreements provide the authority for NPS policies on management of threatened and endangered species: the Endangered Species Act; state-specific endangered species acts; other state wildlife statutes or agreements pursuant to Section 6, ESA; the Migratory Bird Conservation Act; the Fish and Wildlife Coordination Act; the Wild and Scenic Rivers Act; the Marine Mammal Protection Act; the Bald and Golden Eagles Protection Act; the Wilderness Act; the Convention on International Trade in Endangered Species; and maritime and other international agreements.”

The USFWS normally takes lead Departmental responsibility for coordinating and implementing provisions of the Endangered Species Act for all listed endangered, threatened, and candidate species, particularly for all terrestrial plants and animals and freshwater aquatic species. However, for certain listed taxa such as *Cetacea* (all whales and porpoises), most *Pinnipedia* (Steller sea lions, Hawaiian monk seals, etc.), sea turtles, and anadromous fish (steelhead, coho salmon, etc), the NOAA Fisheries plays a very active role under provisions of both the Endangered Species Act (1973) and the Marine Mammal Protection Act (1972). For those marine species including fish it is often a case of shared USFWS\NOAA Fisheries responsibilities, with NOAA FISHERIES frequently assuming the lead role. In each instance discussed below, where the listed species in question is a fish, whale or pinniped, the term “FWS” might more accurately read “NOAA FISHERIES” or “NOAA FISHERIES and FWS.” This is particularly true for any activity that may involve the “taking” of a marine mammal of special status fish species such as threatened coho salmon and steelhead trout.

The federal, state, and CNPS categories for special-status species are defined as:

- Federal endangered: Any species that is in danger of extinction throughout all or a significant portion of its national range.

- Federal threatened: Any species that is likely to become an endangered species within the foreseeable future throughout all or a significant portion of its national range.

- California endangered: Any species that is in danger of extinction throughout all or a significant portion of its range in the state.

- California threatened: Any species that is likely to become an endangered species with the foreseeable future throughout all or a significant portion of its state range.

- California rare (plants only): A native plant that, although not currently threatened with extinction, is present in small numbers throughout its range, such that it may become endangered if its present environment worsens.

CNPS List 1A:	Presumed Extinct in California
CNPS List 1B:	Rare or Endangered in California and Elsewhere
CNPS List 2:	Rare or Endangered in California, More Common Elsewhere

CNPS List 3:	Need More Information
CNPS List 4:	Plants of Limited Distribution

Assessment Methodology

Special Status Plants
Fire plays a role in the life history of many special-status plant species by maintaining open habitat, encouraging reproduction, and affecting competing species. Fire may injure or kill individual plants while the effects on the species as a whole are beneficial because competition has been reduced or openings (i.e., habitat) created. Fire suppression activities can adversely affect these same species because of ground disturbance. Prescribed fires can be detrimental, especially when timing, frequency, and intensity of fire are outside of the natural fire cycle to which the species is adapted. Keeping these factors in mind, the following parameters have been used to evaluate the consequences of the various alternatives on special-status plants:

- The species affected and its degree of local, regional, national, and global rarity.
- The numbers of plants or proportion of the species range affected by the action.
- The response of the species to fire or disturbance (if known).

<u>Type of Impact</u>
Adverse: would lead to loss or alteration of habitat, loss of individuals or populations of special-status plants, or reduction in reproduction.

Beneficial: would lead to increases in suitable habitat, an increase in aerial extent or density of plants, or an increase in reproduction.

<u>Duration of Impact</u>
Short-term: would immediately affect the population or species, but would have no long-term effects to population trends or species viability.

Long-term: would lead to a loss in population or species viability - exhibited by a trend suggesting decline in overall species aerial extent or abundance.

<u>Intensity of Impact</u>
Negligible: Imperceptible or note measurable (undetectable).

Minor: Small, measurable, perceptible and localized, without the potential to increase if left alone.

Moderate: Apparent, measurable, and sufficient to cause a change in the resources (e.g., abundance, distribution, quantity, or quality). Less localized than a minor impact.

Major: Substantial, highly noticeable, and with the potential for landscape-scale effects and major irreversible population effects.

Special Status Wildlife (including fish and other aquatic species)
Like other wildlife species in the project area, special-status species have adapted to natural fire regimes. In many areas, however, a history of fire suppression has led to dense, overgrown stands, with high accumulations of forest fuels. This affects special-status species by altering habitat and placing these species and their habitats at risk of high-intensity, stand-replacement fire. In addition, stand-replacement fire could create unsuitable habitat conditions that would last for many years.

Fire control activities could also adversely affect special-status species through direct disturbance of animals and habitats. Even management actions designed to benefit habitat, such as prescribed fire, can have inadvertent adverse effects on special-status species. With these factors in mind, the following parameters have been used to evaluate the effects on special-status animals of the various alternatives:

- The species affected and its degree of local, regional, nationally and global rarity.
- The rarity of the genotype or subspecies, regionally, nationally, or globally.
- The numbers of animals or proportion of the species range affected by the action.
- The response of the species to fire or disturbance (if known), on a population or sub-population level.

<u>Type of Impact</u>
Adverse: Likely to result in unnatural changes in the abundance or distribution of a special-status species. This could occur through direct disturbance, mortality, or through destruction or alteration of habitat.

Beneficial: Likely to protect and/or restore the natural abundance and distribution of a special-status species. This could occur through protection and restoration of structure, successional state, or distribution of habitat.

<u>Duration of Impact</u>
Short-term: would result in immediate changes in the abundance and distribution of a special-status species, but a return to the original condition occurs within two generations of that species.

Long-term: would result in changes in the abundance and distribution of a special status species that persist for greater than two generations of that species.

<u>Intensity of Impact</u>
Negligible: would be imperceptible or unmeasurable (undetectable).

Minor: would be slightly perceptible and localized in extent; without further actions, adverse impacts would reverse and the resource would recover.

Moderate: would be readily measurable (apparent) and extend further geographically than a minor impact, adverse impacts would eventually reverse and the resource would recover.

Major: would be substantial, highly noticeable, and affecting a large geographic area; changes would be irreversible with or without active management.

Cultural Resources

Policies and Regulations
Fire management actions such as prescribed fire, suppression, and mechanical treatments have the potential to impact cultural resources such as archeological sites, structures, ethnographic resources, and cultural landscapes. Museum objects can also be threatened by such actions, both the physical well being of the objects themselves, and the ability to properly catalog and process those objects.

Section 106 of the National Historic Preservation Act requires Federal agencies to consider the effects of its actions on properties listed in, or eligible for inclusion in, the National Register of Historic Places (i.e., Historic Properties), and allow the Advisory Council on Historic Preservation a reasonable opportunity to comment. Proper management of museum objects is dictated by 36 CFR 79.

Presently the agencies comprising the DOI, including the National Park Service and the U.S. Department of Agriculture, are developing a nationwide Programmatic Agreement with each state's respective Historic Preservation Office, the National Council of State Historic Preservation Offices, and Advisory Council on Historic Preservation. This document will follow procedures outlined in 36 CFR 800.14(b) of Section 106 of the National Historic Preservation Act. Among the core elements of the Programmatic Agreement include professional qualifications, standard protocols for cultural resources compliance for fire management actions, Indian Tribe and public participation, agency review procedures, and inadvertent effects. The benefit of Programmatic Agreement will be greatly expedited Section 106 compliance review for fire management actions, as well as the establishment of standard protocols for most effectively identifying, evaluating, and protecting cultural resources during planned and unplanned fire management actions.

Terms found in Section 106 of the National Historic Preservation Act are used to describe cultural resource significance and effects in this section. However, it is important to distinguish Historic Properties (as defined above) from resources of interest, which are those classes of resources that have some potential to be important, and have the potential to be impaired by the fire management action. While Historic Properties are de facto resources of interest, these might also include sites, features, structures, or other phenomenon that do not meet National Register of Historic Places criteria of significance, the minimum age requirement, and/or possesses sufficient integrity, but contribute somehow to our understanding of prehistory, history, or traditional lifeways, and could be compromised. Each resource of interest is comprised of a set of attributes, called significant characteristics, which lend importance to that resource.

Cultural Resource Impacts Defined
NEPA recognizes three types of impacts - direct, indirect, and cumulative. Direct impacts are those that are caused at the same time and place as the action, indirect impacts occur later in time

and at a distance, while cumulative impacts are additive. In regard to cultural resources, direct, operational, and indirect effect categories are utilized. Direct effects are those where the fire itself is the cause of the impacts, operational effects occur as a result of associated operations like line construction or staging, while indirect effects are ones where fire and/or associated operations result in changes to local context such that cultural resources would be affected. As such, direct and operational effects for cultural resources are the equivalent of direct impacts under NEPA, while indirect effects on cultural resources correspond to indirect and cumulative impacts.

NEPA also dictates that potential impacts are considered in regard to type (adverse, beneficial) duration (short-term, long-term, permanent), and intensity. The Section 106 process considers only the adverse effects upon cultural resources, not potentially beneficial ones. An ordinal scale of impact intensity (negligible, minor, moderate, major) is also foreign to the Section 106 process - effects are either adverse (when the integrity of the historic property is diminished due to the undertaking) or they are not. Duration is not typically factored when assessing effects during the Section 106 process. These issues are considered in greater detail below in relation to direct, operational and indirect effects.

Assessment Methodology

Archeological research ranging from site survey to complex archeological excavations has taken place primarily from the early 1900s through the present. Thirty-two archeological sites on the Point Reyes peninsula were partially excavated from the 1940s through the 1960s by archeologists from the University of California at Berkeley, San Francisco State University, Santa Rosa Junior College, and the Drake Navigators Guild. Information gained from these excavations was critical in placing the Coast Miwok culture within local and regional chronologies and in gathering evidence of early Coast Miwok contacts with Drake and Cermeno.

The following measures are employed to assess impacts of fire management actions on cultural resources. Further rationale for each measure is provided in discussions of direct, operational, and indirect effects that follow.

Type of Impact

Adverse: Changes to the significant characteristics of a resource of interest. These changes may be perceptible and measurable, or, in the case of certain archeological and ethnographic resources, imperceptible, and psychological.

Beneficial: Changes on or in the vicinity of a resource of interest such that the significant characteristics of the resource are protected against adverse impacts of fire management actions and/or restored to some desired condition.

Duration of Impact

Archeological Resources

Short-term Adverse: Changes that result in permanent or temporary loss of data potential in the significant characteristics of a resource of interest, but do not manifest for a period of 10 or fewer years following the fire management action.

Short-term Beneficial: Changes that afford protection to the significant characteristics of a resource of interest from fire management actions for a period of no more than 10 years.

Long-term Adverse: Changes that result in a permanent or temporary loss of data potential in the significant characteristics of a resource of interest, and manifest in more than 10 years following the fire management action.

Long-term Beneficial: Changes that afford protection to the significant characteristics of a resource of interest from fire management actions for a period of no more than 10 to 20 years.

Permanent Adverse: Changes that result in permanent loss of data potential in the significant characteristics of a resource of interest, and manifest immediately following the fire management action.

Permanent Beneficial: Changes that result in permanent protection to the significant characteristics of a resource of interest from fire management actions.

Structures

Short-term Adverse: Changes that result in a permanent or temporary loss of data potential in a resource of interest, but do not manifest for a period of 10 or fewer years following the fire management action.

Short-term Beneficial: Changes that afford protection to the significant characteristics of a resource of interest from fire management actions for a period of no more than 10 years.

Long-term Adverse: Changes that result in a permanent or temporary loss of data potential in a resource of interest, and are manifest in more than 10 years following the fire management action.

Long-term Beneficial: Changes that afford protection to the significant characteristics of a resource of interest from fire management actions for a period of no more than 10 to 20 years.

Permanent Adverse: Changes that result in permanent loss of data potential in a resource of interest, and that are manifest immediately following the fire management action.

Permanent Beneficial: Changes that result in permanent protection to the significant characteristics of a resource of interest from fire management actions.

Cultural Landscapes

Short-term Adverse: Temporary alteration of the significant characteristics of a resource of interest for a period lasting no more than 10 years. Short-term alterations will almost always involve living vegetation.

Short-term Beneficial: Temporary protection, restoration, or maintenance of the significant characteristics of a resource of interest for a period lasting no more than 10 years.

Long-term Adverse: Temporary alteration of the significant characteristics of a resource of interest for a period lasting more than 10 years. Short-term alterations will almost always involve living vegetation.

Long-term Beneficial: Temporary protection, restoration, or maintenance of the significant characteristics of a resource of interest for a period lasting more than 10 years.

Permanent Adverse: Permanent alteration of the significant characteristics of a resource of interest. Permanent alterations will often encompass both living vegetation and other landscape features.

Permanent Beneficial: Permanent protection, restoration, or maintenance of the significant characteristics of a resource of interest.

Intensity of Impact

In this analysis, intensity of impact is measured relative only to adverse resource impacts.

Archeological Resources

Negligible: No or barely perceptible and changes to the significant characteristics of a resource of interest.

Minor: Perceptible and measurable changes to the significant characteristics of a resource of interest, but those changes do not inhibit interpretive potential and/or a minor percentage of the significant characteristics would be affected. Resources prone to impacts in this category might include archeological resources containing a high percentage of resources of interest with low vulnerability to the effects of fire management actions and/or possessing subsurface components.

Moderate: Perceptible and measurable changes to the significant characteristics of a resource of interest, but those changes do not inhibit interpretive potential and/or a moderate percentage of the significant characteristics would be affected. Resources prone to impacts in this category might include archeological sites containing a moderate percentage of resources of interest with low vulnerability to the effects of fire management actions and/or possessing subsurface components.

Major: Perceptible changes to the significant characteristics of a resource of interest, and those changes inhibit interpretive potential of a major percentage of the significant characteristics. Resources prone to impacts in this category might include archeological sites containing a large percentage of resources of interest with high vulnerability to the effects of fire management actions.

Structures

Negligible: Barely perceptible and not measurable changes confined to a single resource of interest or contributing element of a larger National Register district. Changes do not adversely affect significant characteristics.

Minor: Perceptible and measurable changes to a single resource of interest or contributing element of a larger National Register district. Changes do not adversely affect significant characteristics.

Moderate: Perceptible and measurable changes in the significant characteristics of a single resource of interest or small group of contributing elements in a larger National Register district.

Major: Perceptible and measurable changes of substantial magnitude in significant characteristics of a single resource of interest or large group of contributing elements in a National Register district.

Cultural Landscapes

Negligible: Barely perceptible and not measurable changes to a resource of interest.

Minor: Perceptible and measurable minor changes to a resource of interest. For example, a severe wildfire kills a highly visible concentration of non-contributing oak trees located on the boundary of a rural historic cultural landscape.

Moderate: Perceptible and measurable moderate changes in the significant characteristics of a resource of interest. For example, a fire crew cuts down several contributing fruit trees in a rural historic cultural landscape in preparation for a prescribed burn.

Major: Perceptible and measurable changes of substantial magnitude in significant characteristics of a resource of interest. For example, extreme fire behavior and aggressive suppression action destroys a large number of contributing elements within a rural historic cultural landscape.

Visitor Use and Visitor Experience

Policies and Regulations

NPS Management Policies 2001 makes numerous references to aspects of aesthetics as central issues in the considerations that go into resource management. It includes, under the natural resources and values that the NPS must protect, “aesthetic values, such as scenic vistas, natural quiet, and clear night skies.”

Scenic resources are extremely sensitive to air pollution. Even a very small amount of fine particulate matter (less than 2.5 microns in diameter or one tenth the diameter of a human hair) in the air can affect the ability to perceive colors, contrast, texture, and form of features, landmarks, and panoramas. Visual air quality is very important to park visitors. Specific vistas are often mentioned in legislation or Congressional reports concerning the establishment of an NPS unit. Visibility in mandatory class I areas is also specifically protected by the Clean Air Act (Director’s Order-77: Natural Resource Management Guidelines).

This Director’s Order #47 addresses the problem of excessive/ inappropriate levels of noise. It directs park managers to (1) measure baseline acoustic conditions, (2) determine which existing or proposed human-made sounds are consistent with park purposes, (3) set acoustic management goals and objectives based on those purposes, and (4) determine which noise sources are impacting the park and need to be addressed by management. Furthermore, it requires park managers to (1) evaluate and address self-generated noise, and (2) constructively engage with those responsible for other noise sources that impact parks to explore what can be done to better protect parks.

Assessment Methodology

The effects of each alternative were evaluated by analyzing potential impacts on the physical component of the landscape and how the change may be experienced using best professional judgment. The following aspects of actions within the alternatives were assessed as directed by NPS-77:

> Could the action or activity be seen from the park? From a developed overlook, road, or trail? Would the action or activity be continuously or intermittently seen? Are there any alternative sites that are less visible or not visible from the park?
>
> Could the action impact a scenic vista along a road or a scenic view? How long would the fire management treatment impact an area?
>
> Could the action or activity be heard in the park? Where in the park would the sound be most noticeable or intrusive? From developed overlooks, headquarters areas, or trails? Would the sounds be continuous or intermittent? Are there any ways in which the effects of the sound could be mitigated or lessened?

As these questions indicate, systematically looking at the effects of proposed activities or actions aims at evaluating what may be lost, rather than what has been generally thought to describe the existing resource condition. For example, routine baseline monitoring of natural resources would not ordinarily take into account the degree of quiet that characterizes a park or the clarity of night sky, but these are precisely the kinds of issues that come under the framework of aesthetics.

Aesthetic considerations can be quantitatively monitored. It is possible to map viewsheds and photograph visibility. Air quality and weather data can provide limited modeling for visibility and odor concerns. Various characteristics of natural- and human-caused sounds can also be measured.

Unfortunately, there is no objective, numerical standard or threshold that can be employed to state what constitutes an aesthetic effect. As is often the case in NPS management, judgment is necessary. Effects on aesthetics also should be analyzed in the context of cumulative effects of a number of different activities or actions, both within and outside parks. What could be insignificant alone (for example, one helicopter trip near a popular overlook) could become significant in the context of other activities or actions (one helicopter trip in combination with nine diesel buses and a nearby, audible, and visible clearcutting operation).

It is often the case that frequency or duration of an activity or action causes it to be transformed from being acceptable in the park or its vicinity, in aesthetic terms, to being unacceptable. For example, scenic overflights were considered to be acceptable over the Grand Canyon until the numbers and duration of the flights caused a deterioration of the aesthetic experience for other park visitors. Limitations on backcountry use may be based, in part, on the potential for adverse effects on visitor aesthetic experience from too many other users. Sociological studies can be useful to evaluate visitor preferences and aesthetic effects.

Visitor experience is also directly affected by actions influencing natural resources such as air quality, scenic resources, and cultural resources. Though impacts to these resources are not considered again in this analysis of visitor experience, enhancement, or degradation of these resources also enhances or degrades the quality of the visitor experience.

Impacts on visitor experience and visual quality have been assessed using professional judgment to develop a qualitative analysis of the effects of actions on the activities of park visitors. These conclusions have been considered in combination with data on the proportion, when known, of visitors who participate in different activities while in the park.

Type of Impact

Beneficial: would enhance visitor participation, quality of visitor experience, service level, or the visual quality of the landscape.

Adverse: would reduce visitor participation, or degrade the quality of visitor experience, service level, or the visual quality of the landscape.

Duration of Impact

Short-term: would be temporary (less than 90 days) and due to fire management activities such as prescribed burns or mechanical clearing of vegetation.

Long-term: would be permanent and/or continuous.

Intensity of Impact

Negligible: would result in little or no noticeable change in visitor experience.

Minor: would be detectable but localized within a relatively small area (less than 250 acres in one area); would result in changes in visitor experience but would not appreciably limit or enhance critical characteristics.

Moderate: would be highly noticeable, and/or change the visual character of the landscape in areas larger than 500 acres, but affected areas would be located away from heavily used roads or trails; would change the desired visitor experience appreciably, (i.e., changes one or more critical characteristics, or appreciably reduces/increases number of participants).

Major: would be highly noticeable, and/or change the character of the landscape in areas larger than 1000 acres, and affected areas would be visible from heavily used roads or trails; would eliminate or greatly enhance multiple critical characteristics or greatly reduce or increase participation.

Park Operations

Policies and Regulations

Congress established the National Park Service (NPS) in 1916. To fulfill its mission, the NPS receives funding from both the federal appropriations process and other federal revenue sources.

Like most federal agencies, the NPS relies on Federal appropriations to fund its core activities, although there is increasing use of alternative revenue sources, such as fees, to supplement operations. The NPS requests direct Congressional funding and reports on the other federal revenue sources through an annual budget document submitted to Congress entitled “Budget Justifications,” or more popularly called, the “Green Book.”

Financial resources currently available to PRNS include a base-operating budget of approximately $4,949,000, which represents about 115 FTE (full time equivalents or one person for a full year). This work force would be supplemented by 20,000 hours of Volunteers-in-Parks service, 2-4 Student Conservation Assistants, and AmeriCorps volunteer work groups and special project and program funds distributed by the National Park Service regional and Washington offices.

In addition to the above operational funding, the park receives fee revenues and special national park funding for specific maintenance and other projects. For example, the park is expected to receive about $1.6 million in this one-time funding this year for cyclic maintenance on historic structures and other natural resources projects. As part of the San Francisco Bay Network, the National Seashore will have access to approximately $900,000 for natural resource challenge inventory and monitoring funds. Also, the park will receive about $625,000 in fee revenues for other maintenance projects and operation of the whale shuttle system and campground reservation system. In addition, the park receives approximately $1,000,000 in FirePro and Wildland Interface funding for hazardous fuel reduction and fire prevention activities.

Assessment Methodology
Impacts were evaluated by assessing changes that would be required to meet the operational requirements outlined in each of the alternatives. Relative costs were generated, using staff estimates of funding and labor required to implement these actions. These effects were compared to existing operations, staffing, and funding at the Seashore.

Existing staffing levels were inventoried and assessments were made of current park operations. In addition, professional judgments by individuals who are most knowledgeable about various activities were used to anticipate the operational changes that would be needed under each action alternative. Estimates were made of the personnel required to:

- provide education and information services to the public regarding fire activities;
- conduct mechanical treatments to reduce hazardous fuels; and
- conduct prescribed fires to preserve natural and cultural resources and reduce hazardous fuels.

These assessments were compared to existing staffing levels. It should also be noted that staffing and funding impacts for the action alternatives are difficult to project until final plans are completed. Thus, the estimates are intended to provide a general description of potential effects, considering the variability within the range of possible operational scenarios.

The discussions of impacts are for operations that would be new, undergo major change, or show susceptibility to increases or decreases in operational activity.

Type of Impact
Adverse: would represent an increase in operating costs.

Beneficial: would represent a decrease in operating costs.

Duration of Impact
Short-term: would last only until all actions are completed.

Long-term: would have a permanent effect on operations.

Intensity of Impact
Negligible: there would not be a measurable difference in costs from existing levels.

Minor: additions or reductions in cost would be less than 15% of existing levels.

Moderate: additions or reductions in cost would be between 16% and 30% of existing levels.

Major: additions or reductions in cost would be more than 30% of existing levels.

Public Health and Safety

Policies and Regulations

The health and safety of firefighters and the public is the highest priority in every action undertaken as it relates to firefighting strategy and tactics. Director's Order #18 states, "…firefighter and public safety must be the first priority in all fire management activities." National Park Service Management Policies states "all wildland fires would be effectively managed, considering resource values to be protected and firefighter and public safety…." All actions taken involving wildland fire have as their overriding goal providing for firefighter and public safety.

Assessment Methodology

Fire management activities and the potential for injury, illness, and other direct and indirect impacts are evaluated for their potential to affect public and fire personnel during fire management activities at Point Reyes National Seashore. The analysis includes the impacts of prescribed fire, suppression, wildland fire use and mechanical treatment on the health and safety of the public and fire personnel.

Type of Impact

Beneficial: would result in a reduction in human health and safety concerns; or would improve human health or safety.

Adverse: would result in additional or exacerbated public health and safety concerns.

Duration of Impact

Long-term: would have a permanent effect on human health and safety (i.e., contamination of a water source for domestic use would be a long-term impact).

Short-term: would be temporary (less than one month) and would be associated with transitional types of impacts (e.g., safety concerns related to smoke from a prescribed burn).

Intensity of Impact

Negligible: Imperceptible or undetectable effect upon public or fire personnel.

Minor: Minor impacts would be slightly detectable or localized, upon public or fire personnel within a portion of the body.

Moderate: Moderate impacts would be those that are readily apparent but that would not result in limits on activities. Would be clearly detectable and could have an appreciable effect on public health and safety (i.e., introduction of noise, public health hazards or safety hazards).

Major: Major impacts would be substantial, highly noticeable impacts and/or impacts that would result in limits on activities. Would be clearly introducing a significant public health hazard such as the introduction of significant air or water pollution.

Socioeconomics

Policies and Regulations

The NPS regulations for NEPA say "social and economic impacts are considered an integral part of the human environment in the NPS and should be analyzed in any NEPA document where they are affected. Socioeconomic impacts include those to minority and low-income communities as specified in the Environmental Justice Executive Order (EO 12898; Feb. 11, 1994)." This executive order - Federal Actions to Address Environmental Justice in Minority Populations and Low-Income Populations - requires all federal agencies to incorporate environmental justice into their missions by identifying and addressing disproportionately high and adverse human health or environmental effects of their programs and policies on minorities and low-income populations and communities.

Assessment Methodology

In addition to any possible effects on minority and low-income populations and communities, alternatives were evaluated for their potential direct impacts, such as property loss, and indirect economic effects, such as from park closures.

Type of Impact

Adverse: Degrades or otherwise negatively alters the characteristics of the existing environment, as it relates to local communities including minority and low-income, visitor population, regional economies, and concessioners and contractors.

Beneficial: Improves on characteristics of the existing social and economic environment, as it relates to local communities including minority and low-income, visitor population, regional economies, and concessioners and contractors.

Duration of Impact

Short-term: Temporary and typically transitional; associated with implementation of an action.

Long-term: Permanent impacts on the social and economic environments.

Intensity of Impact

Negligible: Undetectable and expected to have no discernible effect on the social and economic environment.

Minor: Slightly detectable and not expected to have an overall effect on the character of the social and economic environment.

Moderate: Detectable and could have the potential to initiate an increasing influence on the social and economic environment.

Major: Substantial, highly noticeable influences on the social and economic environments, and could be expected to alter those environments permanently.

The action alternatives are anticipated to slightly increase annual air pollutant emissions but lower the potential for a large, uncontrolled wildfire with excessive emissions of air pollutants. It is anticipated that after a transition period, natural fire ecology would be closer to pre-suppression return intervals, and the risk of large, catastrophic fires would gradually decline.

IMPACT ANALYSIS

IMPACTS TO SOILS

Alternative A
The actions associated with Alternative A could affect soil resources within the Estero, Limantour Road, Highway One, and Bolinas Ridge FMUs (prescribed fire only).

Types of Impacts
The types of impacts soils can experience from burning are varied, and can include changes to its physical, biological, and chemical properties. The degree of effect on soil is related in large part to the intensity of a fire, although this can change with the property of the soil when a burn takes place as well. Because the types of effects are the same, they are discussed together in this introductory section. The degree of impact, as well as other specific information, is then broken out in the sections on the impacts of prescribed fire and wildland fire.

Soil characteristics
As noted above, the features of soils help in determining the degree of effect of a prescribed burn or wildland fire. Features include biological characteristics, such as the type of vegetation soils support; physical characteristics, such as soil moisture; and chemical characteristics, or soil composition.

Vegetation and Organic Matter. High heat intensities from slow moving fires in heavy fuels can detrimentally affect physical, biological, and chemical properties of soil to varying degrees. Grass fires typically burn quickly over an area and cause little or no soil heating. For example, grassland thatch one centimeter high can serve to insulate soils from heating as a low intensity, fast moving, fire most common in grassland, burns quickly across the top of the litter. Less litter and ground cover can therefore result in greater effects on soil resources. Even the heat generated by heavier fuels involved in chaparral fires in southern California was found to be largely restricted to the surface soil layer and damage to soils was limited (DeBano, et al., 1998). Severe fires can result when humus and large fuels are dry and near the ground conducting much heat into the soil from slow, smoldering fires; recovery in areas that supported heavy dry surface fuels may take years (McNabb and Swanson, 1990; Stanturf, 2002; Christensen, 1994).

Soil Moisture. Under similar fire conditions, dry surface soils will rise to higher temperatures and experience higher impacts than moist surface soils. In the project area, dry surface soils would be more common during wildfire season and moist surface soils common in the seasons when most prescribed burns are conducted. Subsurface saturated soils can actually slow the diffusion of heat and protect underlying soils as heat will be poorly transmitted until moisture in the soil evaporates (Stanturf, 2002).

Soil Type. Granitic soils, such as those found in the Tomales Point and Inverness Ridge FMUs (having Kehoe Variant and Sheridan Variant soils) conduct heat faster than clay-rich soils or soils with a high organic content (Agee, 1993). In the project area, these granitic soils also support some of the more fire dependent plant communities, such as Bishop pine and Marin manzanita. The granitic soils and the overlying vegetation type are thought to contribute to post-fire hydrophobicity.

Range of Effects
The characteristics of soil are important in determining effects, but fires can change the factors described above, as well as other physical, chemical, and biological processes operating in soils. For example, high intensity, slow-moving burns kill soil biota, alter soil structure, consume litter and humus above ground and organic matter within soils, change the rate of water infiltration, reduce the ability of soil to retain water, vaporize important nutrients such as nitrogen and sulfur, and increase erosion of productive top soils (Robichaud, 2000b; Pyne, et.al., 1996; Christensen, 1994).

Erosion. The most common effect on soils is erosion by water, wind, or gravity following the removal of overlying vegetation by fire, whether it is prescribed or wild. The severity and duration of the accelerated erosion depend on several factors, including soil texture, slope, recovery time of protective cover, the amount of residual litter and duff, and post-burn precipitation intensity (Clark, 2001). Erosion selectively removes nutrients, organic materials and fine particles from topsoil reducing soil productivity. A decrease in productivity can have a consequent effect on the density, vigor and range of plant species that will survive or repopulate an area. Reduced productivity may also allow for the establishment or expansion of populations of opportunistic invasive exotic plant species that thrive in poor soils. On a larger scale, the transportation of soils through erosion can result in changes to the landscape such as the formation of gullies or the sedimentation of ponds and wetlands and clogging of stream channels.

The soils with the highest potential for erosion are on the steepest slopes – greater than 50% - along the top of Inverness Ridge. This area primarily supports forests, where replacement of vegetation cover is normally slow in comparison to grasslands or shrublands. De Bano and others (1996) specifically monitoring rates of erosion following a wildfire in ponderosa pine, found sediment yields from a low severity fire recovered to normal levels after 3 years, but moderate and severely burned watersheds took 7 and 14 years, respectively. Areas of the Vision Fire supporting fire dependent species, such as Bishop pine and Marin manzanita, as well as sandy loam soils supporting hardwoods and riparian vegetation appeared to have largely recovered effective soil cover by the second winter following the fire but long-term investigation into recovery of surface soil properties was not conducted.

Hydrophobicity. Hydrophobicity can result when fire increases soil temperatures causing the volatilization of hydrophobic materials into the soil. It is thought that the hydrophobic materials may be deposited by certain plants or are by products of decay (Christensen, 1994). The phenomenon has been highly reported following chaparral fires in Southern California where the gases that result from combustion move downward in the soil as vapors until condensing when cooler soils are encountered forming a nonwettable layer (Pyne et al., 1996). Some soils in the park may be particularly vulnerable to developing deep water repellent layers of soils. These include granitic soils or soils formed from coarse-grained sandstone (such as Kehoe Variant and Sheridan Variant soils) with heavy fuel loads, such as shrubs or trees (Oster, 2003). Granitic soils with a grass cover experience low intensity burns and develop little hydrophobicity. In a hot wildfire, these layers can be quite deep. Following the Vision Fire, erosion and channel cutting was observed in areas of granitic soils cleared of overlying vegetation and exhibiting hydrophobicity from 2 to 8 inches in depth (Collins and Ketcham, 2001). However, the impermeable layer that develops in the upper soil horizon may have beneficial impacts by controlling the loss of moisture to evaporation. This maintains soil moisture and encourages seedling establishment (Clark, 2001). Such a positive impact was observed following the Vision Fire, as by year two, only small areas of hydrophobicity remained having been broken up by the action of sprouting vegetation, decay of organic oils on the soil surface and rilling.

Slope Failures. In addition to increasing erosion, hydrophobicity can also be associated with fire-associated slope failures (DeBano et al., 1998). This happens when the accelerated runoff flowing downslope is circumvented by natural preferential flow-paths within the soil resulting from soil cracks or root channels. When heavy rains occur in areas with susceptible soils, the layer between the surface and the hydrophobic layer can become saturated (Pyne et al., 1996). After a high intensity fire, when roots have burned or are decaying, runoff finds the vertical tunnels left by the roots and moves quickly on these macropore routes causing localized saturation and increasing the potential for landslides and debris flows.

Nutrient Loss and Deposition. Fires can release important plant nutrients, such as phosphate, sulfate and nitrogen, as organic matter is volatilized through combustion both into the air and forced down into the soil (Pyne et al., 1996). Conversely, ash deposits from the fires themselves can increase the amount of nutrients available to plants post-fire, especially nitrogen, and can spur rapid plant growth following the fire. Where rains quickly follow a wildland or prescribed burn, much of the beneficial ash layer can be lost to stormwater runoff. Nutrients are replaced in part by rainfall, dust, pollen, decomposition of downed material, and growth of nitrogen-fixing plants such as *Lupinus, Lotus, Alnus* (Alder) and *Ceanothus* (DeBano, 1998; Agee, 1993).

Post-fire Increase in Soil Temperature. Fires that consume most understory vegetation, reduce canopy cover, and and/or leave a deposit of dark ash can also lead to a subsequent increase in soil temperature from increased absorption and exposure to the sunlight. Under similar moisture regimes, warmer soils increase the rate of decomposition, and nutrient availability to post-fire vegetation and may increase microbial activity and rates of decomposition (Clark, 2001; Christensen, 1994).

Loss of Organic Matter. One of the most noticeable effects of fire on soil is the combustion of organic matter, both on the soil as litter and buried within the soil. Organic matter helps regulate the hydrologic cycle and the carbon/nitrogen ratio, provides a site for nitrogen fixation by N-fixing bacteria, and maintains soil structure porosity and the cation exchange capacity. In Marin soils, the percent of organic matter in the surface mineral layer varies from less than one percent up to ten percent. The Reyes and Sheridan Variant soils have the highest percent organic matter in the duff or surface mineral layer. Other soils with high level of organic matter include Centissima, Dipsea, Maymen, Maymen Variant, McMullin, Palomarin, and Wittenberg soils (Oster, 2003).

Loss of Beneficial Organisms. A small percentage of combustion energy is expended in radiating downward during a fire causing higher temperatures in the upper soil layers. In a hot fire, beneficial fungi and bacteria that live in the soil can be destroyed, and subsurface dwelling wildlife, such as tunneling rodents, can be killed. Populations of microfauna and microflora typically decline following a severe fire but the increase in available nitrogen spurs plant growth which in turn fosters the reestablishment of the soil microorganisms. Often high intensity fires can serve to sanitize soils of pathogens over the short-term and may locally improve soil productivity (Pyne et al., 1996). Prescribed fire may reduce or increase plant pathogens found close to the surface. An increase in populations of Trichoderma, a soil fungus, was found by sampling a ponderosa pine forest following a prescribed burn (Reaves, 1990). Through laboratory analysis, it was determined that these fungi inhibited the growth of Armillaria ostoyae, responsible for serious root diseases in coniferous forests and plantations.

Analysis

Prescribed fire

Prescribed fires generally burn at lower intensities than wildland fires and have fewer associated effects on soil resources. In the project area, prescribed burns are typically scheduled for the fall, winter, or spring - seasons which provide the environmental conditions that fit into the parameters (sufficient fuel moisture, low ambient temperatures, low wind speed, etc.) required to conduct a prescribed burn. The same parameters that permit implementation of prescribed burns also tend to reduce the intensity of a spreading fire, reducing the severity of effects on soil resources. Research has found that, in addition to negative effects, low intensity fire occasionally had beneficial effects on soil, often had no measurable effect and, further, the negative effects often were short-lived (Clark, 2001; Stanturf et al., 2002). These negative effects are primarily erosion and changes in the soil itself, and are described in more detail below.

Erosion. As noted above, the severity and duration of the accelerated erosion depend on several factors, among them, slope, soil type, and the recovery time of protective cover (Clark, 2001). Prescribed burns in the project area would be conducted primarily in moderately sloped grasslands and shrubs and in forested areas to reduce understory growth. These low intensity fires do not fully combust overlying vegetation, duff, and litter; and resultant erosion is limited largely to small patches, even on slopes (Stanturf, 2002). A research project that monitored the post-fire effects following a low intensity prescribed burn over a three-year period found no noticeable increase in either erosion or surface runoff in the burn area (Biswell, 1989, p. 151). Generally, it is thought that slopes that are currently stable would show little increase in erosion after a fire, whereas steeper slopes with soils that currently are subject to erosion would experience accelerated erosion post-fire (Pyne, 1996).

Three of the four FMUs where actions would occur under Alternative A contain areas where soils have a very high erosion potential based on the Natural Resources Conservation Service Erosion Hazard Rating (EHR). Erosion rating indicates that these soils have a very high potential of eroding if disturbed – whether by mechanical means or a natural event. The soils support primarily forests of Douglas-fir, Bishop pine, or redwood and, having slopes ranging from 50% to 75%, are some of the steepest areas in the project site. Roughly one-fifth of the total acreage of the Limantour, Highway One, and Bolinas Ridge FMU contain these soils.

A prescribed burn conducted in the forested areas of the FMUs would target reduction of understory fuels, and although burned areas may experience negligible or minor short-term soil loss until vegetation returns, it is likely areas would be readily revegetated under the near ideal climatic conditions at the Seashore if the burn intensity is low. Prescribed burning would have a relative positive impact on soils by re-introducing more natural fire intervals and intensities to an ecosystem where they have been suppressed. This and the reduction of fuel loading can have an important impact in reducing the potential for more damaging high intensity wildland fires to occur.

Erosion may also occur as a result of the formation of hydrophobic soils. As noted above, this phenomenon can be quite short lasting, even following high intensity wildfires such as the Vision Fire. Because the degree to which hydrophobic soils form is related largely to the intensity of the fire, prescribed burns would result in less severe formation of these water repellent soils for an even shorter period of time (Robichaud, 2000b; De Bano, et al., 1998).

The degree of impact to soils from erosion as a result of prescribed burning would never exceed minor, as defined in the Methodology section for soils. This means fewer than 10% of soils in any given watershed would be affected each year by prescribed burning activities. To ensure no greater than minor impacts, the park would continue its current practice of writing and approving burn plans.

To assure that attention is also given to the protection of soil resources, mitigation measures require that burn plans and associated erosion control plans prepared by the NPS be reviewed by a subject matter expert, such as a hydrologist or erosion specialist, prior to approval for implementation. The subject matter expert would determine whether the erosion control plan submitted is sufficient to prevent long-term moderate or major impacts on the rate of soil erosion. In other words, the expert would determine whether the proposed erosion control strategy would be sufficient to ensure no greater than minor impacts to soils from erosion. If the assessment finds that standard erosion control strategies would be insufficient to avoid a long-term moderate or major effect on the rate of erosion, a separate environmental process would be initiated for that burn plan. Some of the strategies used to minimize impacts to soils are to avoid steep slopes, time burns to maximize favorable environmental conditions, and erosion control devices during burns.

Park fire management personnel focus prescribed burns on areas with gradual to moderate slopes, avoiding steeper areas and ridgetops where fire behavior is less predictive. In doing so, the areas with the more erosion prone soils (granitic soils on the ridgetops) are also avoided (K.

Riggs, pers.comm.). Any prescribed burn proposed for the forested areas would be designed to avoid the steeper slopes not only to reduce potential erosion but also to avoid losing control of the fire and placing firefighters and park and private resources at risk.

In addition to the steepness of the slope, the time it takes for a burn area to revegetate also influences the degree of erosion. In the project vicinity, the Seashore minimizes the time soil is exposed by conducting most prescribed burns in early fall just prior to the winter rains that result in quick revegetation. The park also leaves unburned strips of vegetation along riparian areas in its prescribed burns to reduce soil erosion in steeper slopes leading into drainages. Because prescribed fires are low intensity, they leave behind large woody debris and duff that act as barriers parallel to slopes and trap eroding soils.

Where existing roads and trails do not provide an adequate barrier to help contain a prescribed fire, fire lines are created with hand tools at the perimeter of the burn area. If not rehabilitated following the burn, the linear area cleared for the fire line could become a new drainage channel during heavy rains leading to accelerated soil erosion and a localized change in drainage patterns. The use of standard best management practices, such as the placement of erosion control blankets, sterile rice straw, contour felled logs, and material chipped on site to serve as mulch help to control impacts both during and following prescribed burns. Fire lines would also be scarified to promote revegetation and sufficient large woody debris left within the site to promote nutrient recycling.

The burn plan itself would be reviewed to make sure the yearly prescribed burning in any targeted watershed does not exceed 10% of the total acreage or otherwise have the potential to result in more than minor impacts to soil from erosion. This check would also ensure minimal impacts to water quality or aquatic wildlife. Alternative A would result in the prescribed burning of 500 acres or less, which, as Table 41 shows, is smaller than 10% of the acreage any of the watersheds proposed for treatment. Even if the annual plan for prescribed burning proposed work takes place in a single watershed, it would not be possible to exceed 10% of the acreage. Therefore, the effect of prescribed burning on 10% or less of the vegetation cover would normally be a negligible or minor short-term adverse effect. As noted above, if park review indicated that potential erosion would be greater than this even with the use of mitigation described above, additional environmental analysis would occur.

Table 41. Alternative A, Potential Watershed Level Effects

Watershed (Total Acreage)	**Alternative A FMUs in each Watershed**	**Alt. A FMU acreage within this Watershed**	**% of Watershed within this FMU**	**Potential for Moderate or Major Impact on Watershed Soils**
Bolinas Drainages Watershed (7,902 acres)	Bolinas Ridge Highway One	259 acres 521 acres	3.3% 6.6%	No. 10% of watershed = 790 acres which is > 500 acres (annual limit Alt. A).
Drakes Bay Drainages Watershed (12,758 acres)	Limantour Road	820 acres	6.4%	No. 10% of watershed = 1,276 acres which is > 500 acres (annual limit Alt. A).

Watershed (Total Acreage)	Alternative A FMUs in each Watershed	Alt. A FMU acreage within this Watershed	% of Watershed within this FMU	Potential for Moderate or Major Impact on Watershed Soils
Drakes Estero Watershed (17,720 acres)	Estero Limantour Road	1636 acres 2543 acres	9.2% 14.3%	No. 10% of watershed = 1,772 acres which is > 500 acres (annual limit Alt. A).
Lagunitas Creek Watershed (53,161 acres)	Bolinas Ridge	1339 acres	2.5%	No. 10% of watershed = 5,316 acres which is > 500 acres (annual limit Alt. A).
Olema Creek Watershed (9,397 acres)`	Bolinas Ridge Highway One	606 acres 1347 acres	6.4% 14%	No. 10% of watershed = 940 acres which is > 500 acres (annual limit Alt. A).
Pine Gulch Creek Watershed (5,064 acres)	Bolinas Ridge Highway One	177 acres 1,012 acres	3.5% 14%	No. 10% of watershed = 506 acres which is > 500 acres (annual limit Alt. A).
Tomales Bay Watershed (29,218 acres)	Limantour Road	755 acres	2.6%	No. 10% of watershed = 2,922 acres which is > 500 acres (annual limit Alt. A).

Source: NPS GIS Database, 2003. Calculations are based on the total acreage within each FMP watershed and the total acreage of the FMUs sited either fully or partially within that watershed.

Changes in Soil Characteristics. Though usually more limited in effect than wildland fires, low intensity prescribed burns can result in changes to the upper few inches in the soil horizon (Christensen, 1994). As noted above, impacts can include the loss of nitrogen through combustion and volatilization and changes in subsurface biological activity. Offsetting these adverse impacts would be nitrogen deposited in fire ash and the function of large woody debris, which, when left within the perimeter of a burn promotes nutrient cycling and nutrient exchange between beneficial fungi and plant roots (DeBano, 1998). In addition, although the total amount of nitrogen and other nutrients available at a site may decrease after a fire, volatilization (producing an ammonium form of nitrogen), conversion to organic nitrogen by bacteria and nodules of legumes, such as ceanothus, and a reduction in competing vegetation (Pyne et al., 1996; Christensen, 1994) all act to increase the amount of nutrients readily available to remaining plants. Overall, the impacts of prescribed burning under Alternative A to soil productivity and chemistry would be adverse, short-term and negligible to minor in intensity.

Depending on temperatures reached in the upper few inches of soil, beneficial insects, bacteria, and fungi can be killed, and seeds and plant roots close to the surface can be damaged (DeBano, et al., 1998). Prescribed fire may also have indirect impacts by decreasing the number of soil organisms that hold others in check, ultimately resulting in an increase in what may be harmful pathogens. This was the case in a ponderosa pine forest following a prescribed burn (Reaves, 1990). Overall, Alternative A may result in negligible to minor short-term impacts on organisms in the soils and nutrients in the upper few inches of the soil horizons.

Unplanned Ignitions, Wildfire and Suppression

Wildland fire is both an anticipated element and a variable in the FMP. Wildland fire and the suppression and restoration actions that follow wildland fire all have the potential to affect park soils. Wildland fire typically burns with a higher intensity than prescribed fire due to the dryer conditions of the fuels, higher ambient temperature and the potential for spread to more flammable types of vegetation and landscape conditions. Depending on the intensity and duration of a wildland fire, immediate and long-term changes in soil properties and processes can occur. Suppression activities may also have adverse impacts on soils. In the following section, impacts are described generally for wildfires, which are not expected to exceed 10-30 acres in an average year at the Seashore. These same types of impacts would occur, but be much more serious, in a catastrophic or large-scale wildfire, such as the 1995 Vision Fire. Because these are not part of the 10-15 year planning horizon for this plan, the impacts of catastrophic fire are analyzed throughout this EIS in the section on cumulative impacts.

High intensity, slow-moving wildland fires can effect numerous changes on the physical, chemical, and biological processes operating in soils. Severe burns can have all of the types of impacts described above in the introduction to this analysis and in the section of prescribed burns. The extent of the impact is likely to be more severe in the localized area of the burn, although the acreage burned through wildland fires in this alternative would on average be far less than 10% of that burned in prescription.

Erosion. High intensity wildland fires can remove nearly all of the protective vegetation covering soils, exposing soils to wind or water erosion. As noted above, erosion ultimately reduces soil productivity and vegetation. It can also create conditions under which exotic plant species are better competitors than native vegetation. Bare ground can remain bare for a longer period of time on steeper slopes, or when soils are susceptible to becoming hydrophobic. Clay rich soils subject to very high fire intensity may fuse at the soil surface, decreasing porosity, slowing infiltration of water, and increasing the rate of surface soil erosion. Rain can exacerbate erosion through the rilling of slopes and channel cutting, as well as through slope failure as described above for hydrophobic soils. However, it can also encourage rapid replenishment of organic matter though revegetation.

Changes in Soil Characteristics. A wildfire is likely to burn hotter than a prescribed burn, and can start in a wider variety of vegetation types and under drier conditions. As noted above, certain types of soils in the park are more vulnerable to become hydrophobic following a fire. A hot wildfire, such as may occur in forested areas of the park or where fuels have built up, may create hydrophobic soils deeper in these soils. In particular, granitic soils or soils formed from coarse-grained sandstone (such as Kehoe Variant and Sheridan Variant soils) which support forests of Bishop pine, tan oak, and a brush cover, could become water repellent with resulting erosion of top layers including through rilling, channel cutting and even slope failures. However, based on the short period of time soils remained hydrophobic following the Vision Fire, it is unlikely that the small acres burned by wildfire in a normal year would have more than negligible effects on soil through the formation of water repellent layers.

This is also true of plant nutrients that may be lost through volatilization during a fire. Organic matter on and in soil is also lost or changed through combustion. In a hot wildfire, the loss would be greater than in prescribed burn, as the effects would extend deeper into the soil and would not leave much organic matter on the surface. As noted above, hot fires may also kill beneficial fungi and bacteria that live in soils or wildlife that tunnel near the surface. Because the acreage affected by wildfire is small, and because ash deposits can increase the amount of nutrients to plants following a fire, impacts to soil nitrogen, phosphate, sulfate, organic matter in soils, or biological microfauna or flora from wildfire in a typical year would not be more than negligible or minor.

Unlike prescribed burning, wildfires usually involve suppression activities, such as driving vehicles offroad to reach the site quickly. The weight of these vehicles compacts soils, increasing density and reducing pore size so that both water absorption and root growth are slowed and reduced. Clay and loam soils compact more readily and to a greater degree than sandy soils, and moist soils compact more easily than dry soils. Thick vegetation cover helps reduce potential soil compaction. Compacted areas may revegetate very slowly and tree recovery may take decades (McNabb and Swanson, 1990).

In addition to compaction, suppression activities can cause soil profile mixing, erosion, contamination, and overheating of soils. Manual or mechanized earthmoving to create firebreaks and roads or smother burning materials can mix the layers of the soil horizon, bury the fertile topsoil layer, and the native seedbed within the topsoil reducing the success of post-fire native plant revegetation. Uprooting trees and shrubs and scraping away covering vegetation during these actions expose soils to erosion by wind and water. Removal of covering vegetation and uprooting of plants and tree roots by heavy equipment exposes disturbed soils to erosion by water and wind.

In some cases, suppression activities can be responsible for the most intense impacts to soils. After the Oakland Hills fire, for example most erosion occurred as the result of ground disturbing activities from fire suppression (fire roads, firebreaks) and post-fire reconstruction. Because soil and soil productivity is slow to replace in human timescales, measures to prevent or minimize the impact of suppression are the most effective. Current practice has therefore shifted to limited scope projects that protect specific down-slope resources, such as areas of prior slope failure, water bodies, creeks and structures (Oster, 2003). For example, with the exception of response to a life threatening wildland fire, fire suppression vehicles or heavy equipment used for fire line construction should be directed away from stream channels, riparian areas, wetlands, sensitive biological areas, or perpendicular to slope contours. Park resource advisors working at the fire command center would provide the data and expertise to help fire command minimize impacts during suppression. Assuming these standardized mitigation measures and the small area of the park burned by wildfire each year, impacts to soils from suppression activities would be no more than negligible or minor.

Mechanical Treatments

Erosion. Mechanical clearing is performed by roadway mowing or by power tools. In most cases, plants are cut above ground leaving roots in place to prevent mixing the soil horizon, reduce erosion potential and stabilize slopes. Removal of large non-native trees, such as eucalyptus, often requires heavy equipment and could result in compaction of soils as trees are shifted to staging areas and hauled from the site by large trucks. Following the use of heavy equipment, all compacted areas should be scarified to encourage resprouting from the native seedbed. Standard erosion control strategies, such as erosion control blankets, should be installed as required to prevent erosion. In most cases, these standard erosion control practices are effective in controlling erosion and reducing the effects of compaction that occur during mechanical treatment actions.

Changes in Soil Characteristics. In some instances, it is preferable to manage invasive non-native vegetation by removing the entire plant to prevent the resprouting of cut stalks and reduce the need for repeated treatments. When soils are saturated, plants such as French and Scotch broom pull out with little resistance causing little soil disturbance. This can results in a limited amount of soil horizon mixing as subsurface soils are pulled up with the plant roots. However, mechanical treatment actions rarely result in more than negligible soil disturbance with the exception of large-scale tree removal projects where heavy equipment is employed.

Mechanical treatment for fuel reduction generates large quantities of non-native and native plant material. There are several means of disposal of the vegetation. Chips and other plant material left on the surface soil will eventually degrade and contribute to organic matter and nutrients that improve soil productivity and ability to absorb runoff. Often vegetation is chipped up onsite where it can then be rebroadcasted for weed abatement and erosion control, chipped and removed from the site for use elsewhere for weed abatement, as biomass fuel, or disposal at a greenwaste recycling facility or a landfill. Wood can be left for use as firewood for the community in the project vicinity. A certain amount of wood can be left on site to decompose and provide habitat. The wood should be left in contact with the soil so as not to contribute to ladder fuels. Isolated snags may be left standing for habitat purposes. Broadcasting chips and leaving large debris parallel to the slope all constitute effective soil cover and contribute to controlling erosion by wind, water, and gravity.

Often larger rounds and branches are piled for burning onsite at a time when prescription requirements can be met. Burn piles burn for long periods of time at high temperatures and can impact soils close to the site of the burn (DeBano, 1998). The location of burn piles should be carefully sited away from slopes not only to prevent logs from rolling out of the fire, but to avoid creating a hydrophobic area on a slope that could result in a localized area of hydrophobicity that could accelerate runoff and erosion as well as be more likely to loss nutrient fire ash to stormwater erosion.

Wood from trees infected with Sudden Oak Death has the potential to continue the spread of the disease if wood is transported away from the site of origin. For that reason, all infected wood would be chipped or burned in piles onsite of the fuel reduction project.

Overall, impacts to soil resources from mechanical treatment projects would be adverse, short-term, and negligible to minor in impact intensity.

Wildland Urban Interface Initiative Program

Under Alternative A, projects would be restricted annually to 500 acres of prescribed burning and 500 acres of mechanical treatment in the Limantour Road, Highway One, Bolinas Ridge (fire only), and Estero FMUs. Projects within the Highway One FMU have the opportunity to build upon community projects proposed for the small community of Dogtown. Additional work funded under the WUI initiative for the Dogtown area should considered during annual planning for FMP projects to identify the affected watersheds and assure than no more than 10% of the watershed is affected.

Maintenance of Fire Roads and Trails

Mowing, debris clearing, tree felling along roadways and other actions necessary to maintain reduced fuels and emergency vehicle access on park roads and trails would not affect soil resources in the project area. Actions occur within a 10-foot corridor on each side of the roadway and involve chainsaws, lopers, overhead pruning saws, weedwhips, small trucks, and a mower. With the exception of the mower, maintenance vehicles stay within the margins of the roadway and the actions do not affect soil resources. The mower could disturb restricted areas of surface soil while navigating along the corridor or occasionally cut into surface soils with the changes in topography. Mowing normally occurs after nourishing winter rains have ceased and prior to the beginning of fire season, to be able make the single pass of the mower as efficient as possible. Soils within the 10-foot corridor are largely protected from the action of the mower by the accumulation of the newly cut grass, thatch from previous years and the dense near-surface root system of annual grasses and forbs. Because of the timing of the mowing and the protection afforded by vegetation, thatch, and roots, any erosion of exposed surface soils would be negligible.

Vegetation Clearing Around Buildings

Clearing around buildings can involve pickup trucks, a mower, chain saws, overhead pruning saws, weedwhips, riding mowers, and lopers. Soil disturbance would be limited to occasional contact of the mower blade with soil depending on the topography. Vegetation is cleared around buildings in early spring so residual growth of cut vegetation occurs and the limited areas where soils are exposed would be protected against erosion by wind or water by regrowth, existing thatch cover, and the near-surface root system of annual grasses and forbs. Because of this protection and the timing of the mowing, any erosion of exposed surface soils would be negligible.

Public Information and Education

Fire information and education actions proposed for all alternatives would have no beneficial or adverse effects on soil resources in the project area.

Fire Cache/Park Headquarters Relocation and Construction

The proposed structure would cover approximately 3000 square feet of ground surface. Additional concrete aprons and paved surfaces would be approximately 1000 square feet. Vehicle parking would be gravel. Vehicle washing would occur within curbed paved area and runoff and accidental spills would be captured and wastewater suctioned into a holding tank. The 4,000 square feet of soil affected are located in the most developed area of the park. The ground surface is nearly level and loss of soils during construction could be minimized through the application of standard erosion control practices such as erosion control fabric placed to prevent soil movement. Orange habitat fencing set back from the building envelope and delineating the extent of the working area would prevent unwarranted soil compaction and surface disturbance by heavy equipment.

Cumulative Impacts

Cumulative impacts are those that would occur not as a direct result of this planning effort or actions proposed in the alternative, but in the vicinity of the project area. Appendix C has a list of other planning activities in the project area that are unrelated to this fire management plan. In addition, the Seashore experiences a major wildland fire every few decades. Such a fire would affect all of the same resources described in this EIS under the sections Prescribed Fire and Wildfire and Suppression. It is therefore included in the discussions of cumulative impacts.

Erosion. Assuming a moderate to fairly large wildland fire, the effects to soil resources would be adverse, short- to long-term and moderate to major in intensity. Depending on the severity of the burn, slopes and rainfall intensity, productive topsoil could be lost through erosion throughout the burn area. The soils with the highest potential for erosion are on very steep slopes along the top of Inverness Ridge in Bishop pine, Douglas-fir, and redwood forests. During the very large and catastrophic 12,000+ acre Vision Fire, forested areas and woodlands accounted for roughly 75% of the vegetation burned. Fire intensity was highest on the steep slopes of Inverness Ridge which also have highly erosive granitic soils (BAER, 1996). Active upstream channel cutting was observed in drainages on the west slope of Inverness Ridge. Evidence of erosion was recorded particularly in the granitic soils on the steeper slopes. Many of the soil types within the project area were outside of the burn perimeter of the 1995 fire and the potential effects of fire on rates of erosion have not been observed. Monitoring of other post-fire areas reports elevated erosion rates for two or more years following fires. From research on the Vision Fire, it should be noted that the burn area ranged from 50 to 100% of many watersheds in the burn area. The impacts to soil in these watersheds were major, but within three years, many conditions were trending back to normal (soil chemistry, hydrophobicity, etc.)

Major impacts to soil resources during the Vision fire resulted from compaction and erosion from the use of heavy equipment to construct fire lines, staging areas, and travel corridors for emergency vehicles during fire suppression. Potential effects from heavy equipment include: soil compaction, concentration of runoff water by roads, landings and yarding corridors, mixing of native soil horizon from fire line creation, loss of productive surface soils to erosion due to loss of soil anchoring vegetation cover, increase in potential for surface soil failures (debris flows), soil contamination from the application of fire suppression and retardant compounds, alteration of soil properties as a result of prescribed or wildland fire (e.g., hydrophobicity/water repellency, death of soil organisms, reduced water storage by removal of large woody material, and organic matter overlying and within the soils. De Bano and others (1996) found that moderately and severely burned watersheds took 7 and 14 years, respectively to recover from full effects of the loss of surface soils in the post-fire period of accelerated erosion. Although this is potentially a serious impact, the soils would recover, preventing an impairment of park resources.

Changes in Soil Characteristics. The granitic soils of Inverness Ridge and soils supporting certain chaparral species, such as manzanita, may be prone to develop hydrophobicity. Research has shown that effects of hydrophobicity may last as long as three to four years, but investigations following the Vision Fire experience indicated that water repellency was noted in areas that experience severe fire intensity but had significantly diminished in effect by the second winter storm season following the fire. Areas prone to hydrophobicity and high rates of runoff and low rates of infiltration may also experience mass slope failures and debris flows in steeply sloped areas.

Reduced populations of beneficial organisms and occasionally pathogens follow fires. Also, an immediate decrease in organic material and available nutrients occurs; this is corrected over time by nutrient recycling. Elevation in soil temperatures may contribute to a slower re-establishment of effective soil cover.

As noted above, the use of heavy equipment and other suppression activities can have a variety of adverse effects on soils, some of which can be long lasting. Soil and soil productivity is slow to replace in human timescales; therefore, post-burn management activities that accelerate erosion or create soil compaction must be avoided or minimized to the greatest extent possible. While large-scale erosion control projects are sometimes implemented after a large fire, this has not always proved to be effective from a safety or cost-perspective. Practices that increase soil infiltration and reducing runoff (e.g., seeding) may also increase water storage in the soil and increase the hazard of landslides (Booker et al., 1993). This is why suppression activities are currently more focused on avoiding specific down-slope resources, such as areas of prior slope failure, water bodies, creeks and structures (Oster, 2003). Sensitive resources, such as stream channels, riparian areas, wetlands, or other special biological areas, are also avoided if possible.

Beyond a large-scale wildfire, cumulative impacts to soils would occur from some of the building projects identified in Appendix C. The Giacomini Wetlands Project converts grazing lands to wetlands inundating 560 acres of soils largely formed under wetland conditions. Rather than an impact to soil resources, this represents a restoration of wetland soil resources to a native state. The series of riparian protection projects proposed for the Olema Valley would reduce erosion into the riparian corridors and include exclusionary fencing on Blueline Creek, Giacomini Creek, Cheda Creek, and other tributaries.

Conclusion

The impacts of prescribed burning under Alternative A to rate of soil erosion would be negligible to minor depending on the amount of effective soil cover that remains after the fire and the steepness of the slopes involved. Impacts from erosion would be kept to no more than 10% of soils in the watershed through the use of annual burn plans and NPS review. Soil productivity and chemistry would experience adverse, short-term and negligible to minor impacts from prescribed burning. In the short-term, there may be negligible to minor short-term impacts on organisms in the soils and nutrients in the upper few inches of the soil horizons.

The same types of impacts to soils, e.g., erosion and changes in soil productivity and chemistry, would result from typical wildland fires in the park each year. Suppression activities would add impacts to soils primarily from compaction. Because the number of acres burned by wildfires each year remains quite low, impacts to soils would be short-term, adverse and negligible or minor.

Soil disturbance from mechanical treatment is not expected to result in more than negligible or minor short-term adverse impacts.

Moderate to major short- to long-term adverse impacts to soils from a very large or catastrophic wildland fire are possible. Increases in erosion, formation of hydrophobic soils, gullying, channel cutting, slope failure, and changes to the physical, chemical, and biological nature of soils in the project area are likely in the event of this type of fire. Suppression activities could have additional adverse, short- to long-term moderate to major impacts from soil compaction, mixing, reduced infiltration, loss of vegetation and changes in soils that prevent quick revegetation. Avoiding sensitive resources could keep impacts from becoming major and adverse.

No impairment to park soil resources is expected.

Alternative B

The actions associated with Alternative B could result in both beneficial and adverse effects on soil resources within all 10 of the FMUs within the project area though actions in certain FMUs are limited to either prescribed fire or mechanical treatment. Actions would be permitted within the following FMUs: Tomales Point (mechanical only), Estero, Inverness Ridge (prescribed fire only), Limantour Road, Highway One, Bolinas Ridge (prescribed fire only), Wilderness North, Wilderness South, Palomarin, and Minimum Management FMUs (mechanical treatment only). Alternative B calls for prescribed burning of up to 1000 acres each year, and mechanical treatment of up to an additional 1000 acres.

Analysis

Prescribed Fire

As in Alternative A, impacts to soil resources from prescribed fire projects would be adverse, short-term, and negligible to minor in intensity primarily because the conditions that permit a prescribed burn to proceed also limit the intensity that the fire typically achieves. As noted above, fire intensity is the factor that most affects soil productivity and soil stability by the combustion of organic matter, beneficial organisms, and overlying vegetation cover, volatilization of nutrients, and pulsing of hydrophobic compounds into surface soils. In prescribed burns, fire intensities are would be low with only scattered areas of where readily ignitable fuels burn with a higher intensity. Prescribed fires are also conducted on moderately sloped terrain. These factors all combine to limit the amount of ensuing erosion. Changes to soil characteristics would be similar to Alternative A and limited primarily to the upper soil horizon and correctable through natural processes such as nutrient recycling.

Typically, prescribed fires do not burn with sufficient intensity in the project area to fully combust effective soil cover and expose bare mineral soil except in very limited areas. However, the Seashore nevertheless proposes to limit the aerial extent of annual burning within one FMP watershed to 10% or less of the total watershed area to ensure no greater than minor impacts to soils from erosion resulting from prescribed burns.

While the annual 500-acre cap of prescribed burning under Alternative A automatically limits the potential watershed level effects on erosion to a negligible or minor effect, larger projects are permissible under the 1,000-acre annual cap in Alternative B. Ten percent of the total acreage of three of the watersheds where FMUs slated for prescribed burning in Alternative B is less than 1,000 acres per year. If a group of projects proposed for several FMUs were sited within one of these three watersheds, there is a potential for more than 10% of the effective soil cover in that watershed to be affected.

Mitigation measures relative to watershed level planning are proposed to assure that erosion rates within any one watershed would conform to the conclusions of environmental effect reached in this EIS, e.g., would be no more than moderate in intensity. It would be triggered when proposed actions have the potential to exceed 10% of the total area of one or more FMP watersheds in one year. Mitigation Measure S-2 assures that planning considers the watershed scale, and if a potential effect is identified, that a specific assessment be conducted for the work plan to assure the conformance of watershed level effects with this EIS. Under Alternative B, Mitigation Measure S-2 would be triggered if the annual work plan includes projects that account for more than 10% of the Bolinas Drainages, Olema Creek Watershed, or the Pine Gulch Watershed. As shown in Table 42, the combined project acreage must exceed 790 acres in Bolinas Drainages, 939 acres in Olema Creek Watershed, and 506 acres in Pine Gulch Watershed.

Once it is confirmed that an annual plan for prescribed burning would exceed the 10% level of area in these smaller watersheds, Mitigation Measure S-2 requires an interdisciplinary team evaluation, chaired by the Fire Management Officer, to document the degree of conformance of the proposed actions with the assessment conducted for this EIS.

Table 42. Alternative B: Potential Watershed Level Effects

Watershed (Total Acreage)	**Alternative B FMUs in each Watershed**	**Alt. B FMU acreage within this Watershed**	**% of Watershed within this FMU**	**Potential for More than Minor Impact on Watershed Soils**
Bolinas Drainages Watershed (7,902 acres)	Bolinas Ridge Highway One Palomarin	259 acres 521 acres 1,823 acres	3.3% 6.6% 23.1%	Yes. 10% of watershed = 790 acres which is < 1,000 acres (annual cap Alt. B) and Total FMU acreage in watershed = 33% which could exceeds the 10% target. Mitigation S-2 is triggered.
Drakes Bay Drainages Watershed (12,758 acres)	Limantour Road Palomarin Wilderness N Wilderness S	820 acres 35 acres 327 acres 1,439 acres	6.4% 0.3% 2.6% 11.3%	No. 10% of watershed = 1,276 acres which is >* 1,000 acres (annual cap Alt. B).

Watershed (Total Acreage)	Alternative B FMUs in each Watershed	Alt. B FMU acreage within this Watershed	% of Watershed within this FMU	Potential for More than Minor Impact on Watershed Soils
Drakes Estero Watershed (17,720 acres)	Estero Inverness Ridge Limantour Road Wilderness N	1636 acres 924 acres 2543 acres 74 acres	9.2% 5.2 % 14.3% 0.4%	No. 10% of watershed = 1,772 acres which is >* 1,000 acres (annual cap Alt. B).
Lagunitas Creek Watershed (53,161 acres)	Bolinas Ridge	1339 acres	2.5%	No. 10% of watershed = 5,316 acres which is >* 1,000 acres (annual cap Alt. B).
Olema Creek Watershed (9,397 acres)	Bolinas Ridge Highway One	606 acres 1347 acres	6.4% 14%	Yes. 10% of watershed = 940 acres which is <* 1,000 acres (annual cap Alt. B) and Total FMU acreage in watershed = 20.4% which could exceed the 10% target. Mitigation S-2 is triggered.
Pine Gulch Creek Watershed (5,064 acres)	Bolinas Ridge Highway One Wilderness S	177 acres 1,012 acres 780 acres	3.5% 14% 8.3%	Yes. 10% of watershed = 506 acres which is <* 1,000 acres (annual cap Alt. B) and Total FMU acreage in watershed = 25.8% which could exceed the 10% target. Mitigation S-2 is triggered.
Tomales Bay Watershed (29,218 acres)	Inverness Ridge Limantour Road Wilderness N	326 acres 755 acres 1,190 acres	1.1% 2.6% 4.1%	No. 10% of watershed = 2,922 acres which is >* 1,000 acres (annual cap Alt. B).

There are two findings that could result from the watershed level assessment. Either the annual work plan would conform to or would exceed the level of effect predicted in the FMP EIS. Conformance would show that the proposed actions do include more than 10% and less than 25% of one FMP watershed but effects on the rate of erosion would be readily correctable by standard erosion control practices and would not result in a major impact. Documentation prepared by the interdisciplinary team must be sufficient to demonstrate that the project or projects conformance for the impact areas addressed in the EIS: soils, water quality, vegetation, rare or threatened species, aesthetics, park operations, or visitor experience. The definition of effect must conform to the methodologies applied in this EIS. Documentation would include project-level conditions sufficient where necessary to minimize or avoid major impacts to resources. The completed documentation will be signed by the Superintendent and added to the administrative record for this NEPA process, demonstrating conformance with this EIS. If the assessment found that the work plan does not conform to the findings of this EIS, a separate NEPA review process would be initiated.

Wildland Fire and Suppression

The level of impact to soils from wildland fires or suppression actions in an average year would not change from the level of impacts under Alternative A.

Mechanical Treatments

Alternative B permits twice the level of mechanical treatment than Alternative A. Despite the increase in acreage, the potential effects to soil resources are essentially the same as in Alternative A, as mechanical treatments normally do not disturb surface soils. As with Alternative A, burning of piled materials is used to dispose of cut vegetation. Under Alternative B, roughly twice as much material would need to be recycled chips or firewood, burned in piles, reused as biomass fuel or lumber, or legally disposed. Native plant materials and certain non-natives such as broom can be chipped and broadcast back into the area treated and contributes to effective soil cover. Areas supporting broom typically have such a large number of broom seeds in the soil that the chipped material can serve to help abate the resprouting of seedlings.

Soils below the burn piles can be subject to changes in productivity due to the concentrated effects of high intensity fire. Areas affected would be very limited in extent and would not significantly contribute to increase in soil erosion or decreases in soil productivity. Under Alternative B, impacts to soil resources from mechanical treatment would be adverse, short-term and negligible to minor in intensity.

Actions Common to All Alternatives

Wildland Urban Interface Initiative Program

Under Alternative B, there is much greater potential for in-park projects to complement those community projects funded by the WUI program. By definition, WUI projects are approved in part due to the proximity of the proposal area to the federal wildland interface. The potential to develop projects across management boundaries improves the effectiveness of the individual federal efforts and the community efforts. For example, fuel reduction projects within the Inverness Ridge FMU would build upon risk reduction achieved through matching efforts in Paradise Ranch Estates. Work in the Palomarin and Pine Gulch FMUs would improve the overall effectiveness of efforts funded for the Bolinas community. The overall fuel reduction achieved in Alternative B would provide greater beneficial effects than the limited opportunities provided under Alternative A, however, there is potential for soil disturbance to occur in a limited area where projects overlap jurisdictional boundaries. Mitigation measures require that the Superintendent assure that NPS funded projects for fire management actions in the PRNS Wildland Urban Interface retain sufficient funding in reserve from the full budget to purchase and install erosion control measures found to be required as conditions of NPS project review. Equivalent erosion control must be built into and funded for park and community projects affecting essentially the same soil resource area.

Maintenance of Fire Roads and Trails

Maintenance actions for fire roads and trails would be identical to Alternative A and, as in Alternative A, the limited exposed of surface soils from mowing actions would negligibly affect the rate of erosion. Other soil characteristics would not be affected.

Vegetation Clearing Around Buildings

Clearing around buildings would involve identical actions to those described for Alternative A and would result in negligible effects to the rate of erosion.

Public Information and Education

Fire Information and Education actions proposed for all alternatives would have no beneficial or adverse effects on soil resources in the project area.

Fire Monitoring

Actions associated with the fire-monitoring program are largely observational and non-invasive and would not affect soil resources in the project area.

Fire Cache/Park Headquarters Relocation and Construction

No change to the fire cache proposal occurs under Alternative B. Impacts under Alternative B are the same as those assessed under Alternative A.

Cumulative Impacts

Under Alternative B, impacts from a catastrophic wildland fire event similar to the 12,354-acre Vision Fire would have adverse, major, and long-term impacts to soil resources similar to under Alternative A. As Alternative B permits a higher amount of mechanical treatment and prescribed burning annually than Alternative B, twice as much acreage is treated to reduce fuels than in Alternative A. A primary focus of the actions would be to reduce fuels in the interface area with residential and commercial development. Over time, as more and more acreage is treated and maintained, potential effects from high fire intensity to soil resources would be reduced in the treated areas.

Conclusion

The impacts of prescribed burning under Alternative B on the rate of erosion of park soil resources would be negligible to minor depending on the amount of effective soil cover remaining after a fire and the steepness of the slopes involved. Although impacts from erosion would be greater than those in Alternative A, they would be kept to no more than 10% of soils within a watershed through the use of annual burn plans and NPS review as proscribed in Mitigation Measure S-2. As in Alternative A, soil productivity and chemistry would experience adverse, short-term and negligible to minor impacts from prescribed burning, although the acreage experiencing these impacts would increase. In the short-term, there may be negligible to minor short-term impacts on organisms in the soils and nutrients in the upper few inches of the soil horizons.

Impacts to soils from wildland fires and suppression in an average year in the park would be the same as in Alternative A.

As in Alternative A, soil disturbance from mechanical treatment is not expected to result in more than negligible or minor short-term adverse impacts.

Moderate to major short- to long-term adverse impacts to soils from a very large or catastrophic wildland fire are possible. Increases in erosion, formation of hydrophobic soils, gullying, channel cutting, slope failure, and changes to the physical, chemical, and biological nature of soils in the project area are likely in the event of this type of fire. Suppression activities could have additional adverse, short- to long-term moderate to major impacts from soil compaction, mixing, reduced infiltration, loss of vegetation, and changes in soils that prevent quick revegetation. Avoiding sensitive resources could keep impacts from becoming major and adverse.

No impairment to park soil resources is expected.

Alternative C

The actions associated with Alternative C could result in both beneficial and adverse effects on soil resources within all project area FMUs though actions.

Analysis

Prescribed Fire

As in Alternative A, impacts to soil resources under Alternative C would be adverse, short-term and negligible to minor in intensity. Prescribed burns could be conducted in up to 2,000 acres per year but the increase in acreage would not translate to fourfold increase in effect to soil resources. Mitigation Measure S-1 assures that burn plans address erosion potential and that erosion control plans developed for the burn plans are reviewed by a qualified subject matter expert. Mitigation Measure S-2 assures that impacts on the rate of erosion on a watershed scale disturb no more 10 % of the watershed area unless a specific assessment is conducted to assure that resultant erosion would be readily correctable by standard erosion control practices.

Under Alternative C, the annual cap of 2,000 acres per year is larger than 10% of the area of nearly all of the FMP watersheds with the exception of the two largest watersheds – Lagunitas Creek and Tomales Bay. Under Alternative C, Mitigation Measure S-2 would be incorporated into the preparation process for the prescribed burning annual work plan. When submitted for consideration, the Fire Management Officer would identify the amount of total acres proposed for prescribed burning in each watershed. If the total amount of project acreage exceeds 10% of the total watershed acreage, an interdisciplinary team as directed by Mitigation Measure S-2 would conduct a conformance assessment. The findings of the assessment would be approved by the Superintendent, responsible for NEPA compliance on the park level (NPS, 2000). The conformance assessment would be added to the administrative record for the FMP EIS.

Table 43. Alternative C: Potential Watershed Level Effects

Watershed (Total Acreage)	**Alternative C FMUs in each Watershed**	**Alt. C FMU acreage within this Watershed**	**% of Watershed within this FMU**	**Potential for Moderate or Major Impact on Watershed Soils**
Bolinas Drainages Watershed (7,902 acres)	Bolinas Ridge Highway One Palomarin	259 acres 521 acres 1,823 acres	3.3% 6.6% 23.1%	Yes. 10% of watershed = 790 acres which is <* 2,000 acres (annual cap Alt. C) and Total FMU acreage in watershed = 33% which exceeds the 10% target. Mitigation S-1 is triggered.
Drakes Bay Drainages Watershed (12,758 acres)	Headlands Limantour Road Palomarin Wilderness N Wilderness S	462 acres 820 acres 35 acres 327 acres 1,439 acres	3.6% 6.4% 0.3% 2.6% 11.3%	Yes. 10% of watershed = 1,276 acres which is <* 2,000 acres (annual cap Alt. C) and Total FMU acreage in watershed = 50% which exceeds the 10% target. Mitigation S-1 is triggered.
Drakes Estero Watershed (17,720 acres)	Estero Inverness Ridge Limantour Road Wilderness N	1636 acres 924 acres 2543 acres 74 acres	9.2% 5.2 % 14.3% 0.4%	Yes. 10% of watershed = 1,772 acres which is <* 2,000 acres (annual cap Alt. C) and Total FMU acreage in watershed = 29.1% which exceeds the 10% target. Mitigation S-1 is triggered.
Lagunitas Creek Watershed (53,161 acres)	Bolinas Ridge	1339 acres	2.5%	No. 10% of watershed = 5,316 acres which is >* 2,000 acres (annual cap Alt. C).
Olema Creek Watershed (9,397 acres)`	Bolinas Ridge Highway One	606 acres 1347 acres	6.4% 14%	Yes. 10% of watershed = 940 acres which is <* 2,000 acres (annual cap Alt. C) and Total FMU acreage in watershed = 20.4% which exceeds the 10% target. Mitigation S-1 is triggered.
Pacific Drainages Watershed (10,503 acres)	Headlands Tomales Point	419 acres 923 acres	4.0% 8.8%	Yes. 10% of watershed = 1,050 acres which is <* 2,000 acres (annual cap Alt. C) and Total FMU acreage in watershed = 12.8% which exceeds the 10% target. Mitigation S-1 is triggered.
Pine Gulch Creek Watershed (5,064 acres)	Bolinas Ridge Highway One Wilderness S	177 acres 1,012 acres 780 acres	3.5% 14% 8.3%	Yes. 10% of watershed = 506 acres which is <* 2,000 acres (annual cap Alt. C) and Total FMU acreage in watershed = 17.8% which exceeds the 10% target. Mitigation S-1 is triggered.
Tomales Bay Watershed (29,218 acres)	Inverness Ridge Limantour Road Wilderness N	326 acres 755 acres 1,190 acres	1.1% 2.6% 4.1%	No. 10% of watershed = 2,922 acres which is >* 2,000 acres (annual cap Alt. C).

Wildland Fire and Suppression

No changes in impacts to soils from average annual wildland fires and suppression compared to Alternative A are expected.

Mechanical Treatments

Alternative C permits three times the level of mechanical treatment than Alternative A. Despite the increase in acreage, the potential effects to soil resources are essentially the same as in Alternative A. The key is targeting erosion prone areas within an area to be treated for fuel reduction. Standard erosion control strategies would be sufficient to correct minor erosion problems. Areas with highly erodible soils and steep slopes would not be suitable for mechanical treatments. As with Alternative A, burning of piled materials is used to dispose of cut vegetation. Under Alternative C, roughly three times as much material would need to be recycled chips or firewood, burned in piles, reused as biomass fuel or lumber, or legally disposed. Native plant materials and certain non-natives such as broom can be chipped and broadcast back into the area treated and contributes to effective soil cover.

Actions Common to All Alternatives

Wildland Urban Interface Initiative Program

Under Alternative C, projects within NPS managed lands could treat 2,000 acres annually with prescribed burning and 1,500 acres of mechanical treatment. Compared to Alternative A, Alternative C presents many more opportunities for in-park projects to complement those community projects funded by the WUI program. Projects that benefit Inverness, Inverness Park, Dogtown, Olema, Bolinas, and Point Reyes Station could be paired with extension projects within the park. Projects within the park could target not only fuel reduction but also alternative evacuation routes for both park visitors and area residents. Impacts to soil resources would be controllable by standard erosion control practices and project siting away from steep slopes and highly erodible soils.

Maintenance of Fire Roads and Trails

Maintenance actions for fire roads and trails would be identical to Alternative A and, as in Alternative A, the limited exposed of surface soils from mowing actions would negligibly affect the rate of erosion. Other soil characteristics would not be affected.

Vegetation Clearing Around Buildings

Clearing around buildings would involve identical actions to those described for Alternative A and would result in negligible effects to the rate of erosion.

Public Information and Education

Fire information and education actions proposed for all alternatives would have no beneficial or adverse effects on soil resources in the project area.

Fire Monitoring

Actions associated with the fire-monitoring program are largely observational and non-invasive and would not affect soil resources in the project area.

Fire Cache/Park Headquarters Relocation and Construction

No change to the fire cache proposal occurs under Alternative C. Impacts under Alternative C are the same as those assessed under Alternative A.

Cumulative Impacts

Alternative C permits four times as much prescribed burning and three times as much mechanical treatment as is allowed under Alternative A. Ideally, after 5 years of implementation, 2,500 acres and 10,000 acres could be treated by prescribed fire in Alternative A and Alternative C, respectively. The caps on mechanical treatment would allow 2,500 acres and 7,500 acres of fuel management under Alternative A and Alternative C, respectively. Alternative C treats 12,500 more acres for fuel reduction over a five-year period than Alternative A. If fuel reduction targets critical areas important for wildland fire containment and suppression, Alternative C would be more effective than either Alternative A or B in lowering the risk of a catastrophic fire with its associated effects on soil erosion and productivity. In the long-term, though the potential impacts to soil resources from wildland fire and suppression actions would persist, the risk of a wildland fire and the overall fuel loading would be reduced in the project area in comparison to Alternative A. Despite this reduction in risk, the chance of a moderate, large, or catastrophic fire similar to the Vision Fire would remain with the potential for moderate to major short- to long-term adverse impacts to soil through erosion and changes in soil characteristics as the other alternatives.

Conclusion

The impacts of prescribed burning under Alternative C on the rate of erosion of park soils would be negligible to minor depending on the amount of effective soil cover that remains after the fire and the steepness of the slopes involved. Typically, prescribed fires burn cooler than wildland fire and leave more effective soil cover in place. Prescribed burns are not planned for either gentle or moderately sloped areas that are less prone to erosion. Further, prescribed burns incorporate erosion control techniques as part of the burn proposal. These best management practices are implemented and monitored once installed.

Although impacts from erosion would be greater than those in Alternative A, they would be kept to no more than 10% of soils in the watershed through the use of annual burn plans and NPS review as described in Mitigation Measure S-2. With the exception of the two largest watersheds in the project area - Tomales Bay and Lagunitas Creek – FMU lands constitute more than 10% of the total acreage in the remaining 6 watersheds. Annual plans would be subject to mitigation measures to assure that no more than 10% of a FMP watershed is proposed for FMP actions each year.

As in Alternative A, soil productivity and chemistry would experience adverse, short-term and negligible to minor impacts from prescribed burning, although the acreage experiencing these impacts would be greater than in Alternative A. The impacts are reversible in the short-term and the areas affected have a scattered distribution that reflects overlying burn piles or long-burning fuels. In the short-term, there may be negligible to minor short-term impacts on organisms in the soils and nutrients in the upper few inches of the soil horizons. Beneficial effects can also result from the destruction or reduction of harmful pathogens and fungi that attack plants and roots.

Impacts to soils from wildland fires and suppression in an average year in the park would be the same as in Alternative A.

As in Alternative A, soil disturbance from mechanical treatment is not expected to result in more than negligible or minor short-term adverse impacts.

Moderate to major short- to long-term adverse impacts to soils from a very large or catastrophic wildland fire are possible. Increases in erosion, formation of hydrophobic soils, gullying, channel cutting, slope failure, and changes to the physical, chemical, and biological nature of soils in the project area are likely in the event of this type of fire. Suppression activities could have additional adverse, short- to long-term moderate to major impacts from soil compaction, mixing, reduced infiltration, loss of vegetation and changes in soils that prevent quick revegetation. Avoiding sensitive resources could keep impacts from becoming major and adverse.

No impairment to park soil resources is expected.

IMPACTS TO AIR QUALITY

The standard smoke management techniques listed below are incorporated into all proposed FMP alternatives. Prescribed burns, controlled wildland fire, and suppression actions would be conducted incorporating these best management practices to lessen the effects of smoke and other emissions on human health, ecological health, air quality, and visibility.

If recommended by BAAQMD, burn plans submitted for review could be modified to provide reduced production of pollutants. Recommendations for reducing pollutants are described in the 2002 US Department of Agriculture General Technical Report, Wildland Fire in Ecosystem, Effects of Fire on Air Quality. Recommendations include modifying burn plans reducing the area burned, reducing fuel loading (e.g., mowing and understory thinning away), or managing fuel consumption. Treatments to reduce overall air emissions would include:

- Mowing grass and reducing density of vegetation in brushlands.

- Mechanical treatment of forested areas by removing standing or downed trees, understory thinning, thinning of forests, and creation of shaded firebreaks.

- More frequent, less intense burns to prevent unwanted vegetation from becoming established in clearings or in forest understory.

- Scheduling burns prior to the appearance of new growth.

Increasing combustion efficiency or shifting the majority of combustion away from the smoldering phase and into the more efficient flaming phase would reduce emissions, except NOx, which is produced in greater quantities at higher temperatures. Methods to accomplish this would include pile or windrow burning, rapid mop-up, and shortened fire duration. Pile or windrow burning would generate more heat and burn more efficiently and be most effective in reducing forest fuel rather than brush type fuels.

The park would develop a *Smoke Communication Strategy* to guide management of smoke events during prescribed fires, managed wildland fires, suppression actions, and fires occurring outside the park. Notification of proposed burns would be disseminated through local media and posting to provide adequate advance notice to persons with sensitivities to smoke that burning is planned. Information would be provided to visitors, employees, and residents in smoke affected areas regarding health issues and concerns. The park would monitor particulate levels in the park during large smoke events to provide data for future assessments.

$PM_{2.5}$ monitoring data would be collected at Bear Valley in the Point Reyes National Seashore. Data collected would be shared with local, regional, and national air quality agencies and databases, and can provide a basis for planning fire management or fire fighting activities.

To reduce smoke and pollutant generation during the late summer, early fall, efforts would be made to burn fuel concentrations, piles, landings, and jackpots outside of the prescribed burning season to increase the number of units that can be burned without overloading the airshed on days with good dispersal conditions (NWCG, 2001).

To avoid impacts to visibility in the Class I PRNS portion of the project areas, burning would be avoided on holidays or other periods when recreational visitation is typically high (NWCG, 2001).

To avoid public health and nuisance impacts to neighboring communities prescribed burns would be conducted under meteorological conditions that would avoid smoke drifting into sensitive residential areas and transport smoke away from populated areas. Planning for prescribed burning would also consider the smoldering period to avoid siting fires where downslope winds during the night could carry smoke into residential areas at the base of ridges (NWCG, 2001).

Alternative A

Under Alternative A, a maximum of 500 acres of prescribed burning and 500 acres of mechanical treatment could occur annually within the FMUs.

All prescribed burning at PRNS and the northern lands of GGNRA has been, and would continue to be planned and performed under the auspices of the BAAQMD Smoke Management Program. That program is incorporated in the State Implementation Plan (SIP) for the BAAQMD. The SIP is managed by BAAQMD staff to ensure that all ambient air quality standards and Clean Air Act provisions are met and public health is protected. Prior to igniting a prescribed fire, PRNS Fire Management staff must submit a burn plan to the BAAQMD Smoke Management Program, and obtain meteorological approval to burn from that program. It is the responsibility of these permitting agencies to coordinate the numbers of fires burning in one area. These efforts would ensure that annual emissions from fire management actions implemented under the PRNS FMP do not exceed state or federal standards.

Analysis

Prescribed Fire and Unplanned Ignitions

Emissions. Smoke from unplanned ignitions and prescribed fire is a complex mixture of carbon, tars, liquids, and gases. The major pollutants from fire that are monitored under the Clean Air Act by the BAAQMD are particulates (PM_{10} and $PM_{2.5}$), volatile organic compounds (VOC), and carbon monoxide (CO), and nitrogen oxides ($NOx_{).}$ NOx is produced in relatively small quantities compared to the other pollutants.

As described in the Methodology section, air emissions associated with the amount of burning under Alternative A were estimated using the FOFEM model. The vegetation types used in modeling the emissions are based the principal vegetation communities found at actual prescribed burning project sites in the project area. The burn sites modeled were selected to equal the annual maximum allowable acreage – 500 acres - of prescribed burning under Alternative A. The vegetation type modeled is based on an estimate of the composition of the actual burn sites - roughly 58% grassland, 41% shrublands, and 1% forest. This translates into 291 acres of grasslands, 204 acres of shrublands, and 5 acres of understory burns conducted forested areas as part of limited trials. Included in the model are emissions produced by 30 acres wildland fire occurring annually and split between the three primary vegetation types – 20 acres of grassland, 8 acres of shrublands, and 2 acres of forest.

Transport and fire vehicles such as trucks, engines, and water tenders, etc. would be onsite at the fire to patrol and stand by on alert. For wildfires, air emissions would be generated by chainsaws and graders clearing fuels or providing access, transporting fire fighters, and by heavy equipment and engines used to fight the fire. Wildfire emissions listed may be underestimated since they do not include emissions from fire-fighting aircraft.

The annual levels of emissions produced by prescribed and wildfire burning for Alternative A are summarized in Table 44. The emissions shown represent a conservative estimate; it was assumed that all acres are being burned for the first time. In the event that a prescribed fire unit is burned more than once in the 7-year period, the emissions from that unit would be reduced by approximately 33%.

Table 44. Projected Annual Fire Management Emissions Under Alternative A

Action Type	Acres	Fire Emissions (tons/yr) [a]				
		PM_{10}	**$PM_{2.5}$**	**VOC**	**CO**	**NOx**
Prescribed Fire [b]	495 acres	21.0	17.8	5.5	45.7	1.3
Prescribed Fire Understory Burn	5 acres	2.9	2.4	1.4	28.3	0.8
Wildfire	30 acres	6.0	5.1	2.9	59.4	1.7
Equipment Use During Prescribed Burning or Wildfire Suppression	N/A	0.1	0.1	0.1	1.3	0
Mechanical Treatment	500 acres	0.1	0.1	0.1	1.2	0
Total	1030 acres	30.1	25.9	9.8	134.8	3.8

[a] PM_{10} = Suspended Particulate, $PM_{2.5}$ = Fine Particulate Matter, VOC = volatile organic compounds (methane), CO = Carbon Monoxide, NOx = Nitrogen Oxides
[b] Includes grass and coastal scrub ecosystems and their respective emission factors for prescribed burning.
Source: URS, 2003.

All prescribed burns proposed by the park are approved for ignition by BAAQMD with the objective of maintaining Bay Area Air Basin air pollutant emissions within the national ambient air quality standards listed in Table 44. BAAQMD's decision to permit ignition of prescribed burns is supported by the best available meteorology and forecasting at the time of ignition and allows the agency to coordinate the location and amount of emissions generated simultaneously by prescribed burning in one air basin.

Particulates and Regional Haze. Air quality at the project site is generally good due to the prevailing westerly winds. The air quality of the project area can become degraded when the east Pacific high pressure system becomes displaced; this typically occurs in late summer and early fall when the major atmospheric systems undergo a seasonal change. The result can be a general haze in the air basin, significantly impairing visibility (Sullivan et al., 2001).

The behavior of a smoke plume from a fire, including the direction and elevation that the smoke plume moves, and resulting concentrations at ground level, is highly dependent on elevation and dynamic meteorological conditions at the time. Generally, the higher the elevation of the burn, the greater the mixing volume of air to dilute it is required. Higher elevation winds also tend to better dilute and disperse smoke at lower concentrations. High-level winds may transport dispersed smoke particles large distances. Complex geography and weather patterns complicate the ability to exactly predict the quantity and destination of smoke particles in the plume. Fall and early winter generally have climatic conditions least favorable to smoke dispersion, while spring and summer generally have better conditions for dispersing smoke. Within the project area, prescribed burning is scheduled from early fall through late spring with specific meteorological requirements in the burn prescription for conditions with lower potential for loss of control of the fire and smoke dispersal.

The level of regional haze is an important issue for PRNS, a Class I airshed. The effect of Alternative A on regional haze is assessed by the contribution of additional particulate matter to the airshed through implementation of allowable actions and relative to the size of the management area. As shown in Table 44, all actions under Alternative A could contribute an additional 30.1 tons of PM_{10} to the airshed annually or 0.7 pounds per acre managed based on the FMP management area of 90,000 acres. This additional contribution would be a long-term adverse but negligible effect on regional haze as the additional contribution of PM_{10} would be less than 1 pound per year per acre managed.[1]

Localized Smoke Effects. Generally, smoke effects from prescribed burning last only as long as the duration of the fire management action. Smoke behavior varies with the amount and type of fuel burned. In areas such as the Douglas-fir forests on Inverness Ridge, the fuel load consists of decades of accumulated duff. Because it tends to smolder, duff produces relatively more particulates than burning vegetation. Areas of fire-dependent vegetation, such as the Bishop pine forest that burned in the Vision Fire, have high fuel loading due to fire-induced regrowth but the duff layer would have been lost in the 1995 fire. A higher percentage of fuels would therefore burn in the flaming phase if another fire occurred in this forest, resulting in a significantly lower rate of emissions and smoke generation.

Dense smoke would likely occur in the vicinity closest to wildfire operations. Unhealthful concentrations of smoke would be most likely to affect fire personnel immediately adjacent to the fire. Most smoke plumes from fire suppression operations would disperse at middle to upper elevations and, occasionally, under unfavorable wind conditions, into the more heavily populated areas of Marin County.

In Alternative A, prescribed burning would be conducted primarily in grass and shrub ecosystems. Burns to thin understory in forested areas would be roughly 5 acres per year. Burning would occur in the Limantour, Estero, Highway One, and Bolinas FMUs. Under prevailing wind conditions, smoke generation would generally be confined to the southwest of Highway One or the interior of the park away from the principal residential communities of Olema Valley, Inverness and Inverness Park, and Bolinas. Ranches and residences along Highway One and ranches east of Estero FMU would experience short-term, negligible or minor adverse smoke impacts from prescribed burning.

Mechanical Treatment

Emissions from mechanical treatments were calculated from two sources. The primary source is from equipment used to remove or control vegetation. Mechanical treatments could include mowing roadside vegetation, limbing up trees along roads and trails, creating or maintaining defensible space around structures, and creating or maintaining shaded fuel breaks. Emissions could be generated by the transport vehicles for staff, use of wood chippers, chain saws and weed whips to cut and mulch vegetation, and skidders and excavators to move cut trees.

The second source of emissions is generated by machines used to prepare for and control prescribed burns. Air emissions would be generated by mowers, chain saws and weed whips used to reduce vegetation height and density along the fire perimeter and pre-treat the burn area.

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[1] Based on total tons per year of PM_{10} emissions divided by 90,000-acre project area. 30.1 tons per year X 2000 lbs per ton/ 90,000 acre project area = 0.7 pounds produced per acre managed.

The PM_{10} emissions generated by machinery, vehicles and tools contribute to the adverse, long-term negligible effect on regional haze. Particulate emission levels are shown in Table 44 and discussed under Particulates and Regional Haze.

Fire Information/Education

Actions involved with the fire education program would have neither beneficial nor adverse effects on air quality.

Fire Cache/Park Headquarters Relocation and Construction

The construction of the fire cache building at Bear Valley would have effects on local air quality during the construction period. Construction would generate dust during site preparation that could be controlled through routine watering of dry surface soils and stockpiles. The site is nearly level so only minor site recontouring would be required. Equipment used to construction the buildings would include a front loader, grader, trucks, cement mixer, portable generators, and hand power tools. Construction actions would be short-term lasting three months with limited ground disturbance. Impacts to air quality from emissions of construction-related equipment and grading would result in an adverse, short-term, negligible effect on air quality.

Fire Effects and Fuel Management Research

Actions involved with monitoring, fire effects, and fuel management research would have neither beneficial nor adverse effects on air quality.

Cumulative Effects

Ongoing effects to air quality would occur from implementing Wildland Urban Interface (WUI) projects, maintenance of fire roads and trails, vegetation clearing around buildings, traffic in the park and region, and other sources. The same types of equipment as described above under Mechanical Treatment could be used for clearing, roads and trails and WUI projects, and approximate emissions are included in Table 45 below.

The assessment of cumulative impacts includes the occurrence of a large, high intensity, catastrophic fire similar to the 1995 Vision Fire, which burnt 12,500 acres – 6,000 acres of grasslands, 4,000 acres of shrubs, and 2,500 acres of woodlands. Inclusion of a catastrophic fire of the scale of the Vision Fire as part of the cumulative impact scenario is recognition that current fuel loading within the project area is at a high enough level to support the possibility of a recurrence within the lifetime of the Fire Management Plan.

Table 45. Determination of Cumulative Effect on Air Quality Alternative A

	Emissions (tons/year) [a]				
	PM_{10}	$PM_{2.5}$	VOC	CO	NOx
Alt A: Emissions from FMP Actions[b]	30	25.4	9.9	134.8	3.9
Large-scale Wildfire[c]	6,801	5,763	3,395	72,689	2,077
WUI Community Projects[d]	0.0	0.0	1.0	3.0	0.1
Total Cumulative Emissions @ FMP Year 1	6,831	5,789	3,406	72,826	2,081
Total Cumulative Emissions @ FMP Year 10	6,831	5,789	3,406	72,826	2,081
Cumulative Effect on Air Quality Alt. A, Year 1	Short-term, adverse, major effect on air quality				
% Change in Emissions @ Year 10 of Alt. A Compared to Year 1 of Alt. A	0% change or essentially equivalent to Year 1				
Cumulative Effect on Air Quality Alt. A, Year 10	Short-term, adverse, major effect on air quality				

[a] PM_{10} = Suspended Particulate, $PM_{2.5}$ = Fine Particulate Matter, VOC = volatile organic compounds, CO = Carbon Monoxide
[b] includes acres of 500 acres of prescribed burning with associated mechanical preparation, 500 acres of mechanical treatment and 30 acres of wildfire and mechanical treatment during suppression.
[c] equivalent in scale to the 1995 Vision Fire.
[d] Mechanical treatment only; no prescribed fire.
Source: URS. 2003

As shown in Table 45, the cumulative scenario of a large-scale fire occurring in conjunction with routine FMP actions would constitute a short-term, major, adverse effect on air quality. Modeling indicates the fire hazard potential in Year 10 of the FMP would remain essentially unchanged from that in Year 1. The number of acres treated each year under Alternative A is too limited to make substantial gains on overall fuel reduction within the project area. The cumulative effects on air quality of emissions generated at Year 1 would be essentially the same as in Year 10.

Prescribed burning and mechanical thinning would be geared to controlling exotics and reducing fuels primarily along roadways in four FMUs rather than park-wide. Some of the areas untreated by Alternative A actions include the Douglas-fir forest in the Wilderness FMUs and the bishop pine and shrub communities adjacent to Inverness Ridge residential areas. These untreated areas would continue to be a source of high concern under Alternative A. The potential would continue to exist for large wildfires sufficient to cause significant air quality impacts regionally, especially in the late summer and early fall after vegetation dries and warm, dry easterly winds are common. Smoke impacts from large wildfires could be noticeable at considerable distances inland or along the coast, including in populated areas. The potential adverse, short-term major cumulative effect on air quality is essentially the same in Year 10 of Alternative A implementation as in Year 1.

Conclusion

Particulate emissions generated annually under Alternative A from all FMP actions and wildfires would have a long-term, adverse, but negligible effect on regional haze. Ranches and residences along Highway One and ranches east of Estero FMU could experience infrequent short-term, negligible to minor adverse smoke effects from prescribed burning.

The annual acreage treatment under Alternative A would not appreciably reduce the potential size or severity of a catastrophic wildfire even after a decade of implementation. The cumulative effect on air quality would be short-term, adverse and major at both Year 1 of implementation and at Year 10.

The effects of the fire management program would not represent an impairment of important park resources including the Class I airshed status of PRNS including protection of resources from the effects of contaminants.

Alternative B

Under Alternative B, a maximum of 1,000 acres of prescribed burning and 1,000 acres of mechanical treatment could occur annually within the FMUs.

Analysis

Prescribed Fire and Unplanned Ignitions

Emissions. FOFEM modeling for Alternative B is based on a mock annual work plan of actual prescribed fire project sites comprised of 491 acres of grasslands, 358 acres of shrubs, and 153 of forested understory. The work plan sites are both in PRNS and northern GGGNRA lands with a total acreage equivalent to the maximum annual allowable 1,000 acres. As with Alternative A, representative annual occurrence of unplanned ignitions is 30 acres per year of high intensity wildfire occurring in 20 acres of grassland, 8 acres of shrublands, and 2 acres of forest.

Prescribed burning activity under Alternative B would expand the annual acreage in grass and brush ecosystems compared to Alternative A and include more than 150 acres of understory clearing and pile burning in the forested areas. In addition to the FMUs that would be treated under Alternative A, Alternative B includes the two Wilderness FMUs supporting forested areas that have not burned in at least a century. On a per acre basis, the forested areas in Alternative B produces much higher emission rates on a per acre basis than the grassland/scrublands that comprise nearly all of the acreage treated in Alternative A. The greater level of emissions generated by Alternative B would allow the reduction of fuels at a faster rate than allowed under Alternative A. The goal of the fuel reduction is to reduce the overall potential severity, rate of spread and air pollution emissions that could occur with a large-scale forest fire in the park.

Table 46. Projected Annual Fire Management Emissions under Alternative B

Fire Type	Acres	Fire Emissions (tons/yr) [a]				
		PM_{10}	$PM_{2.5}$	VOC	CO	NOx
Alt B: Prescribed Fires [b]	849 acres	36.8	31.1	9.7	80.0	2.3
Alt B: Prescribed Burns in Forested Understory[c]	153 acres	87.4	74.1	41.8	866.5	24.8
Wildfire	30 acres	6.0	5.1	2.9	59.4	1.7
Equipment Use During Prescribed Burning and Wildfire Suppression	N/A	0.2	0.2	1.5	6.3	0.2
Alt. B: Mechanical Treatment [c]	1,000 acres	0.1	0.1	0.2	2.4	0.1
Totals for Alternative B	2,032 acres	130.5	110.6	56	1,012.6	29

[a] PM_{10} = Suspended Particulate, $PM_{2.5}$ = Fine Particulate Matter, VOC = volatile organic compounds (methane), CO = Carbon Monoxide, NOx = Nitrogen Oxides
[b] Includes grass and coastal scrub ecosystems and their respective emission factors for prescribed burning.
[c.] Includes 1,000 acres of mechanical treatment annually in addition to emissions generated from equipment use during suppression actions and in preparation and execution of prescribed burning.
Source: URS, 2003.

Particulates and Regional Haze**.** Alternative B would produce nearly 3 times more particulates than Alternative A. PM_{10} could be generated at an annual rate of 2.86 pounds per acre managed.[2] This constitutes a long-term, adverse, minor effect on regional haze. A minor effect occurs with particulate generation between 1 and 5 pounds per acre managed per year. The effect is considered long-term as FMP actions would continue to contribute particulates on an annual basis until a level of ecological stability is reached when fuels on half of the FMU acreage is effectively reduced. This would occur at approximately 23 years into FMP implementation. At that point, annual levels of FMP actions could be reduced with associated reductions in particulate generation. During the life of the FMP, roughly 10 to 20 years, the particulate rate would continue to be generated at approximately 2.86 pounds per managed acre per year and constitute a long-term, minor adverse effect on regional haze that should be considered in calculations for long-range, air basin-wide planning goals.

Localized Smoke Effects. Impacts of prescribed fire activity in the surrounding communities would be similar to those described under Alternative A, but with greater frequency. Smoke dispersal from prescribed fires could affect the residents of Inverness, Inverness Park, and possibly the ranches in the north of PRNS as well as ranches along Highway 1 as in Alternative A. The same may be true for residents on the mesa area north of Bolinas. The requirements of burn prescriptions call for conditions that maximize smoke dispersal to the extent allowable without compromising control of the prescribed burn. As a precaution, prescribed burn perimeters would be generously buffered from any developed areas as a precaution. However, prevailing winds could result in smoke being blown towards the communities in the vicinity of the project area. In cases such as this, residents and the community at-large would be notified in advance of prescribed burning. Potential effects of nuisance smoke in the general locality of the prescribed burn would constitute a short-term, adverse, negligible to moderate impact from nuisance smoke.

Mechanical Treatment

Emissions produced by the mechanical treatment of 1,000 acres were modeled using standard generation factors for typical equipment used in these projects. Hours of use per acre are based on the experience of the PRNS Fire Management Officer. Projects included a mix of mowing, understory treatment, shrub density reduction, creation of shaded fuel breaks and roadside clearance treatment. Also modeled was equipment use in support of preparation and control of prescribed burns and the emissions generated by equipment and vehicle use in suppressing wildfire. As shown in Table 46, emissions from mechanical treatment are a negligible component of overall emissions generated annually under Alternative B but still contribute to the

[2] Based on total tons per year of PM_{10} emissions divided by 90,000-acre project area. 129.6 tons per year x 2000 lbs per ton/ 90,000 acre project area = 2.88 pounds produced per acre managed.

long-term, adverse, minor effect on regional haze, which is assessed on an annual basis as one emission level.

Fire Information/Education

Actions involved with the fire education program would have neither beneficial nor adverse effects on air quality.

Fire Cache/Park Headquarters Relocation and Construction

Effects of the construction of the fire cache building at Bear Valley are equivalent to those noted for Alternative A. Dust and emissions generated by heavy equipment during construction of the fire cache would be an adverse, short-term, negligible effect on air quality.

Fire Effects and Fuel Management Research

Actions involved with monitoring, fire effects, and fuel management research would have neither beneficial nor adverse effects on air quality.

Cumulative Effect

Several assumptions needed to be made in order to analyze the cumulative effects of annual fire management actions and a large-scale, catastrophic wildfire. The maximum allowable acreage of annual treatment under Alternative B would double the amount of fuel reduction achieved each year compared to Alternative A, the No Action Alternative. This doubling of annual treatment produces a progressive reduction in the size and severity of the large-scale fire until eventually the project area is returned to a more balanced return fire interval approximately 23 years into project implementation when half of the FMU acreage would have been treated and maintained. An important assumption is that the 2,000 acres treated annually under Alternative B would results in a corresponding reduction in the scale and severity of the large-scale wildfire that comprises the cumulative scenario.

If a large fire occurred within a few years of implementation of Alternative B, its scale is more likely to be similar to that generated under Alternative A. Three years into implementation, Alternative B would have begun to yield a noticeable reduction in fuel loading throughout the project site. The scale and intensity of a large-scale wildfire could reasonably be assumed to be proportionally downsized so that three years into implementation, the potential air emissions generated by a large-scale fire would be reduced roughly 17% compared to the emission potential in Year 1. By the Year 10 of implementation, sufficient fuel reduction actions would have occurred to reduce potential emissions 55% compared to Alternative A representing a short-term, major, beneficial cumulative effect on air quality.

By Year 23 (and beyond the planning horizon of this FMP), a more natural fire regime over a wide portion of the park would be accomplished by consistently expanding the treated acreage and reducing the size and severity of a large-scale wildland fire. A catastrophic fire at Year 23 would affect 2,500 acres rather than 12,500 acres (equivalent to the Vision Fire) and would produce 84% less emissions than the Vision Fire equivalent. .

Cumulative effects are assessed at both FMP inception (Year 1) and Year 10 of implementation, nearly halfway towards the goal of more natural fire regime. By year 10, FMP actions would have been effective in reducing the scale of a potential catastrophic fire by 50% to 6,250 acres.

Table 47. Determination of Cumulative Effect on Air Quality Alternative B

#		Emissions (tons/year) [a]				
		PM_{10}	$PM_{2.5}$	VOC	CO	NOx
1	Alt B: Emissions from FMP Actions[b]	130.5	110.6	56	1,012.6	29
2	Emissions of Large-scale Wildfire, Year 1[c]	6,801	5,763	3,395	72,689	2,077
3	WUI Community Projects[d]	0.0	0.0	1.0	3.0	0.1
4	Total Cumulative Emissions @ FMP Year 1 (1+2+3)	6,931.5	5,873.6	3,452	73,704.6	2,101.1
5	Emissions of Large-scale Wildfire, Year 10[e]	3,050	2,585	1,517	32,405	926
6	Total Cumulative Emissions @ FMP Year 10 (1+3+5)	3,180.5	2,695.6	1,574	33,420.6	955.1
7	% Change in Emissions @ Year 10 Compared to Year 1 (6÷4)-1.0	54.1% reduction in potential emissions				
8	Cumulative Effect on Air Quality of Alt. B, Year 10 Compared to Alt. A Year 10	Short-term, major, beneficial, cumulative effect on air quality				

[a] PM_{10} = Suspended Particulate, $PM_{2.5}$ = Fine Particulate Matter, VOC = volatile organic compounds, CO = Carbon Monoxide
[b] includes acres of 1,000 acres of prescribed burning with associated mechanical preparation, 1,000 acres of mechanical treatment, 30 acres of wildfire.
[c] equivalent in scale to the 1995 Vision Fire.
[d] Mechanical treatment only; no prescribed fire.
[e] 10 years of FMP actions have effectively reduced the potential size of the large-scale wildfire by 50% to 6,250 acres.
Source: URS. 2003

At Year 1 of FMP implementation, the potential scale of a catastrophic wildfire is the same for all alternatives. Alternative B doubles the number of acres treated annually to reduce fuel loading compared to the No Action Alternative. Unlike treatments under Alternative A, the annual cap on acreage treatment in Alternative B is sufficient to begin effectively reducing the potential risk of a large-scale fire in the project area. Each year, as a larger area of the FMUs are treated and maintained, the potential severity and extent of a catastrophic wildfire is correspondingly reduced. This would also reduce the level of emissions produced each year as the FMP is implemented. At Year 10 of Alternative B, the size of a potential large-scale fire would be half that under Alternative A. This 6,250-acre fire would present a short-term, major adverse effect on air quality in and of itself. However, relative to the potential emissions that would be generated under the No Action Alternative, Year 10 of Alternative B would be a relative short-term, major, beneficial effect on air quality by producing nearly 46% less emissions than under Alternative A.

Conclusion

On an annual basis, Alternative B would generate higher levels of particulate emissions than the No Action Alternative; twice as many acres would be subject to FMP actions each year. Alternative B would produce 2.86 pounds of PM_{10} per acre managed a long-term, adverse, minor effect on regional haze. This additional contribution would be offset by the long-term opportunity presented by Alternative B to achieve a major, beneficial reduction in the emissions that could result from a catastrophic fire as compared to the cumulative effect under Alternative A. Nuisance smoke would be an infrequent, short-term, adverse, negligible to moderate air quality impact for residents near prescribed burns during the duration of the burn.

The effects of the fire management program would not represent an impairment of important park resources including the Class I airshed status of PRNS including protection of resources from the effects of contaminants.

Alternative C

Under Alternative C, a maximum of 2,000 acres of prescribed burning and 1,500 acres of mechanical treatment could occur annually within the FMUs.

Analysis

Prescribed Fire and Unplanned Ignitions

Emissions**.** Modeling of emissions under Alternative C is based on a representative work plan comprised of actual project area burn sites totaling 2,000 acres. The project sites include 968 acres of grasslands, 756 acres of shrublands, and 276 acres of understory forest burns annually. Understory burning produces very high emissions compared to prescribed burns in grass or coastal scrub. The No Action Alternative included only 5 acres of understory prescription burning compared to the 276 acres modeled for Alternative C. So even if the annual acreage permitted for prescribed burning is only four times greater under Alternative C compared to the No Action Alternative, the levels of emissions produced are many times greater than the difference in the acreage amounts alone. For example, understory burning of 5 acres under Alternative A would generate 2.9 tons per year of PM_{10} while understory burning of 276 acres per year in Alternative C would produce 157.7 tons per year of PM10. So there is no direct correlation between the amounts of emissions produced and increasing the allowable acres fourfold. The increase in emissions is more dependent on the type of fuels treated than the amount of acreage included.

Table 48. Projected Annual Fire Management Emissions under Alternative C

Fire Type	Acres	Fire Emissions (tons/yr) [a]				
		PM_{10}	$PM_{2.5}$	VOC	CO	NOx
Alt C: Prescribed Fires [b]	1,724 acres	77.1	65.2	20.0	163.8	4.7
Alt C: Prescribed Burns in Forested Understory[c]	276 acres	157.7	133.7	75.3	1,563.1	44.7
Wildfire	30 acres	6.0	5.1	2.9	59.4	1.7

Equipment Use During Prescribed Burning and Wildfire Suppression	N/A	0.3	0.3	2.8	11.8	0.3
Alt. C: Mechanical Treatment [c]	1,500 acre	0.2	0.2	0.3	3.6	0.1
Totals for Alternative C	3,530 acres	241.3	205	101.3	1,801.7	51.5

[a] PM_{10} = Suspended Particulate, $PM_{2.5}$ = Fine Particulate Matter, VOC = volatile organic compounds (methane), CO = Carbon Monoxide, NOx = Nitrogen Oxides

[b] Includes grass and coastal scrub ecosystems and their respective emission factors for prescribed burning.

[c.] Includes 1,000 acres of mechanical treatment annually in addition to emissions generated from equipment use during suppression actions and in preparation and execution of prescribed burning.

Source: URS, 2003.

Particulates and Regional Haze. All actions under Alternative C would generate 5.3 pounds per acre managed of PM_{10}. The contribution to regional haze would be considered long-term, as the contribution would be an addition to current ambient emissions over the implementation period of Alternative C. However, Alternative C has the shortest predicted implementation period of the FMP alternatives. Because the amount of acreage treated is the highest in Alternative C and the greatest number of forested acres are treated, a more stable fire condition – i.e., successful FMP implementation - is achieved in the shortest time period. The more stable fire condition is considered attained when half of the FMU acres have been treated and are being maintained at low fuel levels. Allowable annual actions under the No Action Alternative A are so limited both in acreage and FMUs treated that little or no progress is made towards the effective reduction of fuel loading in the project area. Alternative B achieves the lower hazard stable fire condition at Year 23 of implementation. Alternative C would greatly accelerate the process, achieving stable fire ecology at Year 13.

As a result of a shorter implementation period, the long-term contribution of additional PM_{10} to regional haze from implementation of Alternative C would be relatively short compared to Alternative A, which has no predictable length until goals are met. Over the 13-year period of implementation, PM_{10} emissions from Alternative C would be a long-term, adverse, moderate effect on regional haze. The 5.3 pounds per acre managed meets the criterion for moderate effect, i.e., greater than 5 pounds and less than 10 pounds annually per acre managed.

Localized Smoke Effects. Impacts of nuisance smoke due to prescribed fire in the surrounding communities would be similar to those described under Alternative A, though occurring with more frequency and, in the case of understory burns, more intensity. Nuisance smoke could be noticeable during the period of active burning to residents in Inverness, Inverness Park, the northern ranches, and residents of homes and ranches along Highway 1, and in Bolinas. If burns are conducted adjacent to one or more residences, it may be necessary to advise these residents to remain indoors during the course of the burn, perhaps for one day. Residents within fifteen miles of the park might occasionally notice a brief impact from prescribed burning activities, possibly in slightly increased haze or light smoke impacts. Visitors to the park would also encounter haze or smoke more frequently during late fall through early spring when burns are conducted. Beyond that range, prescribed burning impacts are unlikely to be noticeable with any frequency. Alternative C could have a short-term, adverse, minor to moderate effect on park visitors and area residents.

Mechanical Treatment

The annual emissions generated under Alternative C for mechanical treatment of 1,500 acres are shown in Table 48. Also shown are the emissions produced by equipment and vehicles used preparing for and controlled prescribed burns and during the suppression of wildfires. Emissions generated by mechanical treatment are a short-term, negligible adverse effect on regional haze when viewed in isolation. As contribution to regional haze is assessed by pounds per acre managed on an annual basis, these emissions are considered part of the full contribution of all actions under Alternative C to regional haze. These emissions would have a moderate, adverse, long-term effect on regional haze of which emissions from mechanical treatment are a negligible component.

Fire Information/Education

Actions involved with the fire education program would have neither beneficial nor adverse effects on air quality.

Fire Cache/Park Headquarters Relocation and Construction

The construction of the fire cache building at Bear Valley would have short-term, minor adverse effects on local air quality during the construction period as in Alternative A.

Fire Effects and Fuel Management Research

Actions involved with monitoring, fire effects, and fuel management research would have neither beneficial nor adverse effects on air quality.

Cumulative Effects

Past, present, and reasonably foreseeable projects that might have a cumulative impact under Alternative C would be the same as those for Alternative A for the first year of FMP implementation. As each year's fire management actions are completed, it is assumed that a corresponding reduction in the scale and intensity of a potential large-scale wildland fire is achieved. Because Alternative C treats the highest number of acres per year, the highest amount of forested acres, and includes all FMUs within the project area, this alternative would achieve more significant in-roads in reducing fuel loading in the shortest time period. A more stable fire ecology and less hazardous condition would be achieved by Year 13 of FMP implementation under Alternative C.

To compare the estimated emission potential under Alternative C, the level of effect on air quality achieved in Year 1 and Year 10 is compared to the cumulative effect of Alternative A and are presented in Table 49. At Year 10, 35,000 acres would have been either treated or retreated for maintenance under Alternative C. The corresponding reduction in the potential size of a large-scale wildland fire would be roughly 3,000 acres. This size fire event would produce approximately 80% less emissions than the Vision Fire-scale event possible under Alternative A or Year 1 of implementation of Alternative C. A 3000-acre wildfire, though much smaller than the Vision Fire-scale event, would still produce a short-term, adverse and major effect on air quality and regional haze. However, relative to the 12,500-acre fire possible under Alternative A, Alternative C represents a short-term, major beneficial cumulative effect on air quality and regional haze.

Table 49. Determination of Cumulative Effect on Air Quality Alternative C

#		Emissions (tons/year) [a]				
		PM_{10}	$PM_{2.5}$	VOC	CO	NOx
1	Alt C: Emissions from FMP Actions[b]	241.3	205	101.3	1,801.7	51.5
2	Emissions of Large-scale Wildfire, Year 1[c]	6,801	5,763	3,395	72,689	2,077
3	WUI Community Projects[d]	0.0	0.0	1.0	3.0	0.1
4	Total Cumulative Emissions @ FMP Year 1 (1+2+3)	7,042.3	5,968.5	3,497.3	74,493.7	2,128.6
5	Emissions of Large-scale Wildfire, Year 10[e]	1,359	1,152	674	14,372	385
6	Total Cumulative Emissions @ FMP Year 10 (1+3+5)	1,600.3	1,357	776.3	16,176.7	436.6
7	% Change in Emissions @ Year 10 Compared to Year 1 (6÷4)-1.0	77.3% reduction in potential emissions				
8	Cumulative Effect on Air Quality of Alt. C, Year 10 Compared to Alt. A Year 10	Short-term, major, beneficial, cumulative effect on air quality				

[a] PM_{10} = Suspended Particulate, $PM_{2.5}$ = Fine Particulate Matter, VOC = volatile organic compounds, CO = Carbon Monoxide
[b] includes acres of 1,000 acres of prescribed burning with associated mechanical preparation, 1,000 acres of mechanical treatment, 30 acres of wildfire.
[c] equivalent in scale to the 1995 Vision Fire.
[d] Mechanical treatment only; no prescribed fire.
[e] 10 years of FMP actions have effectively reduced the potential size of the large-scale wildfire by 50% to 6,250 acres.
Source: URS. 2003

Conclusion

On an annual basis, Alternative C would generate the highest levels of particulate emissions compared to the No Action Alternative and Alternative B. This is a result of the greater number of acres treated each year and the larger number of forested acres, which produce the highest emission levels. Alternative C would produce 5.3 pounds of PM_{10} per acre managed a long-term, adverse, moderate effect on regional haze. Contributions of PM_{10} to regional haze would be a long-term, adverse, moderate effect for 13 years rather than the indeterminate period under Alternative A.

This additional contribution would be offset by the long-term opportunity presented by Alternative C to achieve a short-term, major, beneficial, cumulative effect on regional haze relative to the emissions produced under the cumulative scenario in Alternative A.

Nuisance smoke would be an infrequent, short-term, adverse, negligible to moderate air quality impact for residents near prescribed burns during the duration of the burn.

The effects of the fire management program would not represent an impairment of important park resources including the Class I airshed status of PRNS including protection of resources from the effects of contaminants.

IMPACTS TO WATER RESOURCES AND WATER QUALITY

Alternative A

Under this alternative, 500 acres of prescribed burning and approximately 500 acres of mechanical treatment would occur over an average year. The actions associated with Alternative A could affect water resources and water quality within the Estero, Limantour Road, Highway One, and Bolinas Ridge (mechanical treatment only) FMUs.

Analysis

Prescribed Fire

Prescribed fire could have impacts on water resources and water quality during site preparation (e.g., fire line construction) or as a direct result on the fire itself. As noted in the Affected Environment discussion, water quality can be affected by increases in total suspended solids (TSS) or increases in nutrients results from a fire. The features of a watershed, including soil conditions, overland flow, and other hydrologic variables could also be affected.

Fire changes vegetation, forest floor cover (e.g., ground vegetation, litter, or duff), structure, and soil properties, all of which can alter the movement of water over, or into, the soil. In the first years following a fire, watershed storage capacity is reduced and net surface runoff is increased as a result of reduced soil cover, lack of soil cover, and/or increased soil hydrophobicity (water repellency). These changes can result in channel extension, upland erosion, and stream channel incision. These changes to hillslope process result in increased discharges, soil erosion, and higher sediment yield, affecting aquatic habitat conditions within the watershed.

The heating of soils from prescribed or wildland fires can lead to development of a water repellent layer at or below the surface of the soil, a condition called hydrophobicity. This layer reduces the infiltration capacity of the soil and increases the potential for overland flow. The higher the fire intensity/severity, the deeper in the soil this layer will form. A water repellent layer below the soil surface is likely to cause more soil erosion than such a layer at the surface, as the soils that lie above the water repellent layer can be moved as a debris flow. Fire associated hydrophobic conditions decay over time as the integrity of the hydrophobic layer is reduced. In the case of the Vision Fire on Inverness Ridge, the hydrophobic layer was patchy by the end on the second winter after the fire (Collins and Ketcham, 2001). Water repellency is more common in coarse-textured soils, such as those derived from granite parent material. Hillslope process in burn areas with high fire intensities is most acutely affected by hydrophobic soil conditions.

Fire can reduce the capacity of slopes to attenuate rainfall through loss of vegetation and soil cover, and through reduction in soil permeability. After fire, overland flow and rills often develop in areas where surface flow did not previously occur. Observations in the granitic soils of Inverness Ridge following the Mt. Vision Fire showed the effects of the fire to include channel network extension through rilling. Hydrologic storage capacity (ratio of runoff to precipitation) is further decreased through delivery of water through flow tubes consisting of abandoned animal burrows or rotted out root paths (Collins and Ketcham, 2001). In addition, the Vision Fire area after the first rains displaced most of the ash; the exposed soil quickly developed a crust of tine particles that essentially sealed the surface from infiltration. This was observed by Onda et al. (1996) who determined that during the initial storm of the season after the fire, the runoff ratio was 10 times higher than normal and 50% of the runoff was caused by the surface crust, not the hydrophobicity. Collins and Ketcham (2001) also found in the lower Muddy Hollow watershed after the Vision Fire minimum sediment increases of 2,626 tons/sq/mi/yr occurred. Sediment supply to lower Muddy Hollow Creek in the second year was 2.7 times higher to the lower watershed during second year after the fire than the first year. This is likely due to the lag time of sediment transport through a watershed.

Under prescribed fire, fuel moisture, weather conditions, time of day, spatial pattern of ignition, and other factors are effective means of controlling the fire. Given these controlling factors, prescribed fire would not generally result in high severity fire that would alter watershed conditions. Burn blocks would be limited in size (less than 200 acres). Burns would not be continuous up the vertical gradient of the watershed (meaning from the bottom/riparian area through mid-slope, and into or through the slope of the ridge.

Under prescribed fire parameters, fire in the duff layers would spread under variable conditions, but not with enough severity to cause extensive areas of hydrophobic soil.

In addition, prescribed fire in the duff layers would spread across the watershed under variable conditions so that burn severity would range locally from light to severe. Patches of extremely hydrophobic soils would be created in areas of high fuel loading where soils would be exposed to heating for a longer time and at a higher temperature than where fires burned in lighter fuels. However, these hydrophobic areas would be patchy in burned areas and not extensive because of the controlled burning conditions that are required to conduct prescribed fire. For example, weather, fuel moisture, and wind speed must be within certain limited parameters.

The effects would not typically be on a watershed scale because prescribed fires are less than 200 acres and the program would not treat more than 10% of the watershed in any one year. In addition, prescribed burning would be only in part of the watershed, either upper, lower, or middle sections, with limited intrusions into riparian areas. Increases in water yield and peak flows would occur on a watershed scale but would be within the natural range of variability. Because of the temperate climate in Point Reyes, vegetation growth is rapid and increases in sediment and nutrient yield fluctuations would be short-term (Wong, 2003). As a result, there would be only negligible erosion of primary and secondary stream channels as a result of increased runoff, and the recovery of riparian systems would occur quickly, in one to two years. Therefore, short-term and negligible to minor water quality impacts would result from increased surface runoff and soil erosion on a watershed scale.

Periodic prescribed fire would help keep plant communities within their natural range of variability. Fire frequency was about every 8-14 years before European settlement. Where fire return intervals are out of cycle, fuel accumulations can be well outside their natural range of variability, and when catastrophic fire occurs the impacts to water quality are severe (Ketcham, 2003).

Prescribed fire would be used as a means to reduce the severity and intensity of large-scale catastrophic fire that directly causes negative impacts to water quality such as increasing sediment loads. In addition prescribed fire would also limit the potential for catastrophic fire that could burn along the entire vertical gradient in the watershed and creating extensive hydrophobic soils resulting in increased sediment loads to watersheds (Ketcham, 2003). Because of the above, prescribed fire in the long-term would have beneficial effects on watersheds by reducing the severe impacts of a catastrophic fire that could extensively burn an entire watershed.

To sum, the effects of prescribed fire on watershed conditions would be beneficial, long-term, and moderate because of the restoration of natural hydrologic process. Effects on water quality would be adverse, minor and short-term from prescribed fire due to some limited degradation of water quality from soil disturbance, removal of the duff layer, and altered flow patterns.

Mechanical Treatments

Under this option, 500 acres would be treated by mechanical means, including hand cutting and mowing. Because of the labor-intensive nature of hand cutting, no more than about 100 acres could be treated by this means each year. Hand cutting activities would lead to soil compaction on a localized scale and would likely have a negligible effect on duff and topsoil layers, resulting in negligible direct impacts on watershed characteristics, including water yield, peak flows, sediment yield, nutrient yield, and stream system response. Thus, the effects of hand cutting would be adverse and short-term, but only negligible in intensity to water quality.

Hand cutting projects would be limited in size, with boundaries typically associated with only one portion of the slope (top, mid-slope, or bottom). Water yield and peak flows would increase only slightly, and within a small range of variability, thus sediment and nutrient yield would only see short-term fluctuations. As a result, there would be negligible channel response, with short-term effects, if any, in riparian systems.

Piles of cut wood debris would be burned. Pile burning could create small patches of hydrophobic soils, which, depending on conditions, could experience light to severe changes. Biological and physical characteristics of these patches would be expected to change. However, because of the small areas, the biological function of these areas would return very quickly, and the effect on a watershed scale would not be noticeable. The impact of pile burning on water quality would be adverse, short-term, and minor.

Mowing would be used in this alternative to treat the majority of acres. Mowing would be used where air quality, visitor use, or other management concerns prohibit burning or where mowing is the preferred option, such as where maintaining a cultural landscape. Mowing would lead to soil compaction on a localized scale, but would likely have a negligible effect on duff and topsoil layers, resulting in negligible direct impacts on watershed characteristics, including water yield, peak flows, sediment yield, nutrient yield, and stream system response. Water quality impacts from mowing overall would be adverse, short-term, and negligible.

Overall, the watershed effects within these areas would be beneficial, long-term, and minor to moderate by reducing fuel loads and reestablishing the natural hydrological cycle as described under prescribed fire above. Where fire return intervals are out of cycle, fuel accumulations can be well outside their natural range of variability and when a watershed level wild fire occurs the impacts to water quality are severe (Ketcham, 2003).

Mitigation Measures

W-1. Individual burn plans would be written with enough detail to determine the extent of erosion within the burn area due to a) the prescribed burn and/or, b) mechanical treatments. Subject matter experts would determine if the erosion control plan submitted is sufficient to prevent long-term moderate or major impacts to the water resources and water quality. Strategies to minimize erosion and sediment transport to water resources associated with prescribed burning include avoiding oversteep slopes, timing burns to minimize erosion potential, or using erosion control devices after burns. Strategies to minimize erosion and sediment transport to water resources associated with mechanical treatment include avoiding oversteep slopes, avoiding scraping or clearing to bare mineral soil (leave duff layer), or installing erosion control devices as part of mechanical treatment (if necessary).

W-2. Watershed level planning would be used to assure that prescribed burning and/or mechanical treatment within any one watershed would conform to the conclusions of the environmental effect reached in this EIS (e.g., the impacts would be no more than moderate in intensity). Watershed level planning would be triggered when proposed actions have the potential to exceed 10% of the total area of one or more FMP watersheds in one year. This mitigation measure assures that planning considers the watershed scale and, if a potential effect is identified that a specific assessment be conducted for the burn plan to assure the conformance of the watershed level effects within this EIS.

The above two mitigation measures would ensure minimal impacts to water quality or aquatic wildlife. Alternative A would result in the prescribed burning of 500 acres or less, which, as Table 41 shows, is smaller than 10% of the acreage any of the watersheds proposed for treatment. Even if the annual plan for prescribed burning proposed work takes place in a single watershed, it would not be possible to exceed 10% of the acreage. Therefore, the effect of prescribed burning on 10% or less of the vegetation cover would normally be a negligible or minor short-term adverse effect. As noted above, if park review indicated that potential erosion would be greater than this even with the use of mitigation described above, additional environmental analysis would occur.

W-3. Helispots, staging areas and spike camps will be located at least 100 feet away from streams, creeks, and other water bodies.

W-4. All fireline (both handline and dozer line) would be rehabilitated as quickly as possible, which would include application of Burned Area Emergency Rehabilitation (BAER) techniques such as recontouring, soil stabilization as needed, and monitoring for erosion and treatment as necessary in the first winter following disturbance.

W-5. When developing prescribed burn boundaries, non-treatment buffer areas would be established around perennial, intermittent, and ephemeral channels associated with Lagunitas Creek, Olema Creek, Pine Gulch Creek, and other coastal drainages originating from Inverness Ridge. Some treatment within buffer areas, including hand removal of non-native species and "cool" burns of non-native grasses, may occur within these areas. Fire lines around these areas would be mowed - not graded or scraped - in order to leave a 100-foot vegetated buffer strip from burn areas.

Unplanned Ignitions, Wildfire, and Suppression

Annually, the park has approximately three unplanned ignitions resulting in 30 acres of vegetation impacted. Suppression activities in these areas would have potential to alter flow patterns and increase soil erosion because vegetation and organic litter would be removed to stop or hold a fire.

Erosion would be greatest along stretches of fire line that run down slope. Soil compaction and disturbance would occur with activities during both hand line preparation (a hand line is usually several feet wide where vegetation is removed to bare soil to stop a fire) and mop-up (clean-up after a fire is suppressed). Water bars and check dams would continue to be used as mitigation, to dissipate runoff and reduce erosion. Downed snags would create locally heavy areas of fuels that would, on a very small-scale, affect the temperature and residence time of a fire.

Holding Action and Monitoring Effects (water and retardant drops, helispots, and spike camps).

Helispots would be located at least 100 feet away from any stream or waterbody and typically on or near a topographic high. Because of the relatively small surface area and location, helispots would typically have little effect upon water quality or other watershed attributes. Spike camps for monitoring and holding crews would be located in similar areas as helispots. They have the potential to be larger, especially as crew-size increases, but even so, effects would be generally localized. Both helispots and spike camps would contribute to areas of increased compaction and disturbance in the soils if needed. Water quality effects of these actions would be adverse, short-term, and minor.

Retardant and suppressant compounds would not typically move into ground water or into surface water from runoff as they would be used carefully around surface waters because of potential effects upon aquatic organisms. Most fire retardants contain fertilizer type compounds, including ammonia and nitrogen. Although the half-life of these compounds in soil is short, they can cause changes in pristine terrestrial and aquatic ecosystems, especially to bodies of water that are otherwise low in nitrate/ammonia type nutrients like those in the study area. Additionally, ammonia itself can be quite toxic in aquatic habitats. Some retardants also contain preservatives that release cyanide that can be fatal to aquatic life. To minimize impact, pilots and engine crews would be directed to avoid dropping retardants within 300 feet of wetlands, streams, and lakes. This buffer zone would eliminate any potential direct discharge to these water resources because soil would quickly absorb the retardant and vegetation would also impede flow to any water resource. The use of such a wide buffer zone would prevent moderate or major adverse effects from the use of retardants and suppressants, and would keep impacts to water quality and watersheds to short-term negligible or minor adverse effects.

Fire Information/Education

This would have no beneficial or adverse effects on water resources, the hydrology of the area, or water quality.

Fire Cache/Park Headquarters Relocation, and Construction

The proposed structure would cover approximately 3000 square feet of ground surface. Additional concrete aprons and paved surfaces would be approximately 1000 square feet. Vehicle parking would be gravel. Vehicle washing would occur within curbed paved area and runoff and accidental spills would be captured and wastewater suctioned into a holding tank. The 4,000 square feet of soil affected are located in the most developed area of the park. The ground surface is nearly level and loss of soils during construction could be minimized through the application of standard erosion control practices such as erosion control fabric placed to prevent soil movement. Orange habitat fencing set back from the building envelope and delineating the extent of the working area would prevent unwarranted soil compaction and surface disturbance by heavy equipment. Overall, the construction of a fire cache at Bear Valley would not have a beneficial or negative impact on water quality and water resources.

Fire Effects and Fuel Management Research

This would have no beneficial or adverse effects on water resources, the hydrology of the area, or water quality.

Cumulative Impacts

Cumulative impacts to water quality could occur from construction or compaction from activities described in Appendix C, or from a wild fire. When considered in combination with the minor to moderately beneficial impacts of projects (except a large-scale fire) of other projects listed in Appendix C, the cumulative impacts from Alternative A would be adverse, short-term, and minor. The majority of the impacts are related to short-term compaction of soils and disturbance to duff layers.

Extensive burned areas that may be continuous from ridgeline to slope bottom and include riparian areas characterize high-severity fires in Point Reyes such as the Vision Fire. Water yield and peak flows increase following high severity fire because soil infiltration rates decrease and there is little vegetation to intercept precipitation or organic litter (duff) to slow water runoff. Extensive and continuous areas of hydrophobic soils are created, further decreasing infiltration and increasing water yields. This was observed by Onda et al. (1996) who determined that during the initial storm of the season after the fire, the runoff ratio was 10 times and the surface crust, not the hydrophobicity, caused 50% of the runoff. Collins and Ketcham (2001) also found in the lower Muddy Hollow watershed after the Vision Fire minimum sediment increases of 2,626 tons/sq/mi/yr occurred. Sediment supply was 2.7 times higher to the lower watershed during second year after the fire than the first year.

A large-scale fire would cause an increase in sediment and nutrient yields in the watershed and corresponding increased rates of erosion and sediment deposition in channels. This would impact both water quality and the physical characteristics of channels and their associated aquatic habitats. Channels would not reestablish their pre-fire character until the vegetation re-colonized and stabilized hill slopes and channel banks. However, because of burn severity in the riparian areas, reestablishment of vegetation would take several years. During extreme weather events, debris torrents would potentially scour streams, delaying restoration of the riparian community for even longer. Thus, with the cumulative impacts of a large-scale catastrophic fire, the effects of Alternative A on water resources and water quality include areas of adverse, potentially long-term, and major change. However, vegetation would return in the long run, as it has following the 12,000+ acre Vision Fire, and scouring and overland flow would return to rates within the natural rate of variability, preventing impairment of park resources.

Conclusion

To sum, the effects of prescribed fire on watershed conditions and natural hydrology of the burn areas through reducing the risk of catastrophic fire and returning more natural fire intervals would be beneficial, long-term, and moderate. Effects of prescribed fire to water quality related to increased erosion would be adverse, minor and short-term until vegetation is reestablished. Impacts from soil disturbance related to mechanical treatments would be adverse, short-term, and negligible to minor. However, the watershed effects within these areas treated by mechanical means would be beneficial, long-term, and minor to moderate.

In aggregate, actions implemented under this alternative would have adverse, short-term, and minor effects to water quality. In the long-term, the actions of Alternative A would have a beneficial, long-term, moderate to major effect in restoring the natural hydrology of the area.

A large-scale unplanned fire could have adverse, potentially long-term, and major impacts to both water quality and features of watersheds, including riparian zones and watercourses.

No impairment to park water resources would result from implementing Alternative A.

Alternative B

Analysis

Prescribed Fire

In this alternative 1000 acres of prescribed burning would occur over an average year. Although the number of acres treated by prescribed fire is increased above Alternative A, the types of impacts from Alternative B are the same as those described for Alternative A. Also, because the burn units are dispersed throughout the park in the various FMUs (no concentration of impacts within a watershed) the total acres treated in relationship to the 90,000 acres within park boundaries is still relatively small (less than 2%). Therefore, beneficial impacts to the watershed from the removal of large fuel loads (protection from catastrophic fire) and the reestablishment of a natural hydrological process due to treatment with prescribed burning would still fall in the moderate range in the context of the entire study area. However, compared to Alternative A, benefits would be twice that of Alternative A because of the additional acres treated. Although effects on water quality from prescribed fire would occur over a larger area in this alternative relative to the No Action alternative, they would remain adverse, minor and short-term in the context of the entire study area. They may be quite noticeable on a localized basis compared to Alternative A, however.

Unplanned Ignitions, Wildfire, and Suppression

Same as Alternative A. Water quality effects of these actions would be adverse, short-term, and minor due to soil compaction and use of fire retardants. However, the overall acres, approximately 30, are minor compared to the total acres (90,000) within the park (less than 1%).

Mechanical Treatments

Under Alternative B, the total acres treated by mechanical means would increase to 1000. Although this is double that treated in Alternative A, it is still a relatively small (less than 2%) percentage of the 90,000 acres in the study area. In addition, treatment would be dispersed among eight FMUs (Alternative A would include mechanical treatment in three FMUs). Therefore in the context of the entire study area, benefits to watershed characteristics from mechanical treatment by reducing fuel loads and reestablishing the natural hydrological cycle would remain long-term, and minor to moderate as they are in Alternative A.

Water quality impacts from mechanical treatments would be adverse, short-term, and negligible due to soil disturbance and vegetation removal that may cause erosion. Overall, long-term, minor to moderate beneficial effects on the watershed would result from reestablishing natural hydrological cycles, eliminating exotic vegetation, and reducing the potential for catastrophic fire. Compared to alternative A, the relative impacts to both water quality and watershed characteristics may be readily noticeable on a localized basis as the number of acres treated would double.

Mitigation Measures

Same as Alternative A. While the annual 500-acre cap of prescribed burning under Alternative A automatically limits the potential watershed level effects on erosion to a negligible or minor effect, larger projects are permissible under the 1,000-acre annual cap in Alternative B. Ten percent of the total acreage of three of the watersheds where FMUs slated for prescribed burning in Alternative B is less than 1,000 acres per year. If a group of projects proposed for several FMUs were sited within one of these three watersheds, there is a potential for more than 10% of the effective soil cover in that watershed to be affected.

The W-2 mitigation measures relative to watershed level planning are proposed to assure that erosion rates within any one watershed would conform to the conclusions of environmental effect reached in this EIS, e.g., would be no more than moderate in intensity. It would be triggered when proposed actions have the potential to exceed 10% of the total area of one or more FMP watersheds in one year. Mitigation Measure W-2 assures that planning considers the watershed scale and, if a potential effect is identified, that a specific assessment be conducted for the work plan to assure the conformance of watershed level effects with this EIS. Under Alternative B, Mitigation W-2 would be triggered if the annual work plan includes projects that account for more than 10% of the Bolinas Drainages, Olema Creek Watershed, or the Pine Gulch Watershed. As shown in Table 42, the combined project acreage must exceed 790 acres in Bolinas Drainages, 939 acres in Olema Creek Watershed, and 506 acres in Pine Gulch Watershed.

Once it is confirmed that an annual plan for prescribed burning would exceed the 10% level of area in these smaller watersheds, Mitigation Measure W-2 requires an interdisciplinary team evaluation, chaired by the Fire Management Officer, to document the degree of conformance of the proposed actions with the assessment conducted for this FEIS.

Fire Information/Education

Same as Alternative A. Fire education and information programs would have no beneficial or adverse effects on water resources, the natural hydrologic process, and water quality.

Fire Cache/Park Headquarters Relocation, and Construction

Same as Alternative A. The construction of a fire cache at Bear Valley would not have a beneficial or negative impact on water quality and water resources. The building would be located at least 100 feet from riparian zones and temporary construction plastic fencing would be used to eliminate any sediment reaching the creek during rain events.

Fire Effects and Fuel Management Research

Fire research would have no beneficial or adverse effects on water resources and quality.

Cumulative Impacts

No cumulative impacts beyond those described for Alternative A would occur.

Conclusion

In the context of the 90,000 acre study area, the impacts to water quality and watershed characteristics of Alternative B would be nearly indistinguishable from Alternative A. Treatment with prescribed fire and through mechanical means would result in long-term, moderate to major benefits to watersheds from the reestablishment of the natural hydrological processes, elimination of exotics, and reduction of fuel loads and potential for catastrophic wildfire. Compared to No Action, the benefits could be quite noticeable on a localized basis.

Impacts to water quality over the entire study area from soil disturbance, erosion and sedimentation from these same activities would have similar adverse, short-term, and negligible to minor impacts to water quality as Alternative A. However, because the treated acreage would double in this alternative, localized impacts to water quality may be quite noticeable.

A large-scale unplanned fire could have adverse, potentially long-term, and major impacts to both water quality and features of watersheds, including riparian zones and watercourses.

No impairment to park water resources would occur from implementing Alternative B.

Alternative C

Analysis

Prescribed Fire
In this alternative 2000 acres of prescribed burning would occur over an average year. In the context of the 90,000 acre study area, treatment of 2000 acres would not have impacts to watersheds or water quality readily distinguishable from those in No Action. As in both Alternatives A and B, treatment would have beneficial, long-term and moderate impacts to water resources through reducing fuel loads and the potential for catastrophic fire, controlling exotic vegetation and reestablishing natural hydrological processes. However, even though the number of acres burned would remain relatively small, it would be four times the number treated in the No Action alternative, and twice that in Alternative B. Smaller scale positive changes in fuel loading, ground cover, soil condition and other features contributing to hydrologic processes may therefore be much more noticeable under Alternative C than the other alternatives.

This is true of short-term impacts to water quality as well. Although soil disturbance and resulting sedimentation from activities necessary to carry out or control prescribed burns would have on negligible or minor park wide adverse effects to water quality, localized erosion may be more noticeable or longer lasting under this alternative.

Unplanned Ignitions, Wildfire, and Suppression

Same as Alternative A. Water quality effects of unplanned ignitions and fire suppression actions would be adverse, short-term, and minor due to soil compaction and use of fire retardants. However, the overall acres, approximately 30, are minor compared to the total acres (90,000) within the park (less than 1%).

Mechanical Treatments

Although the total acres treated mechanically in this alternative is 1500 acres, this is still a small percentage (less than 2%) of the total study area, and compared to it would have only the same minor to moderate benefits to hydrological processes by controlling exotics, reducing the potential for catastrophic fire, and helping to reestablish natural hydrologic cycles as either Alternative A or C. Mechanical treatment would also be dispersed over a wider area than in the

No Action alternative, and so benefits to watersheds would be difficult to distinguish from other alternatives. However, as noted above, 1500 acres is significantly greater than the 500 acres Alternative A would treat, and on a local basis, improvements to hydrologic processes may be quite noticeable.

The same is true for water quality. Over the entire study area, water quality impacts from mechanical treatments would be adverse, short-term, and negligible to minor due to soil disturbance and vegetation removal that may cause erosion. However, because more acres are treated, it is likely that either a greater number of streams or other bodies of water would experience temporary sedimentation or higher turbidities in others than in the No Action alternative would occur.

Mitigation Measures

Same as Alternative A. FMP watersheds with the exception of the two largest watersheds – Lagunitas Creek and Tomales Bay. Under Alternative C, Mitigation Measure W-2 would be incorporated into the preparation process for the prescribed burning annual work plan. When submitted for consideration, the Fire Management Officer would identify the amount of total acres proposed for prescribed burning in each watershed. If the total amount of project acreage exceeds 10% of the total watershed acreage, an environmental analysis would be conducted by an interdisciplinary team as directed by Mitigation Measure W-2.

Fire Information/Education

Same as Alternative A. Fire education and information programs would have no beneficial or adverse effects on water resources, the natural hydrologic process, and water quality.

Fire Cache/Park Headquarters Relocation, and Construction

Same as Alternative A. The construction of a fire cache at Bear Valley would not have a beneficial or negative impact on water quality and water resources. The building would be located at least 100 feet from riparian zones and temporary construction plastic fencing would be used to eliminate any sediment reaching the creek during rain events.

Fire Effects and Fuel Management Research

The actions under this alternative would have no beneficial or adverse effects on water resources and quality.

Cumulative Impacts

No cumulative impacts different from those described under the No Action alternative would occur in Alternative C.

Conclusion

In the context of the 90,000 acre study area, the impacts to water quality and watershed characteristics of Alternative C would be difficult to distinguish from Alternative A. Treatment with prescribed fire and through mechanical means would result in long-term, moderate to major combined benefits to watersheds from the reestablishment of the natural hydrological processes, elimination of exotics, and reduction of fuel loads and potential for catastrophic wildfire. Compared to No Action or Alternative B, the benefits could be quite noticeable on a localized basis.

Impacts to water quality over the entire study area from soil disturbance, erosion, and sedimentation from these same activities would have similar adverse, short-term, and negligible to minor impacts to water quality as Alternative A. However, because the treated acreage would be quite a bit larger in this alternative, temporary localized impacts to water quality may be more noticeable.

A large-scale unplanned fire could have adverse, potentially long-term, and major impacts to both water quality and features of watersheds, including riparian zones and watercourses.

No impairment to park water resources would occur from implementing Alternative C.

IMPACTS TO VEGETATION

Types of impacts

Numerous activities associated with wildland fire, prescribed fire, wildland fire suppression, and mechanical treatments can have either adverse or beneficial impacts on vegetation. Impacts can be sustained by individual plants, or by plant communities. Examples of impacts to individual plants include direct mortality or physical damage resulting from burning, or from mowing or cutting vegetation for fireline. A plant community level impact would occur if cutting fireline or prescribed burning led to the establishment or spread of non-native invasive plants, which could alter plant community species diversity and function. Mitigation such as monitoring and the removal of non-native plants would limit these effects.

The impacts of fire on vegetation are a function of the severity of the fire itself and characteristics of the plants on the site. The ultimate response of a plant or a plant community to fire is related to the type of fire (e.g., surface vs. crown), fire behavior, fire duration, fire intensity, the season in which the fire burns, and how recently the area burned in the past. Fuel quantity and arrangement, fuel moisture content, topography (e.g., slope and aspect), wind speed, and the structure of the plant community itself cause the lethal heat zone to vary significantly in time and space (Miller, 2000). This means fire effects on plants can vary not only widely among fires, but also among different areas on the same fire.

Species and individual plants respond uniquely to fire based on plant age, vigor, morphology, reproductive strategies (e.g., seeders vs. sprouters), germination requirements, and phenological state at the time of the fire. Trees, shrubs, and herbaceous species all respond differently to fire, and exhibit numerous strategies for post-fire colonization, including sprouting and seeding. The amount of subsurface heating that occurs, as well as the amount of organic matter removed from the soil surface affects plants and regeneration. Post-fire weather also influences post-fire species establishment (e.g., which species will recolonize the site and how quickly) and affects the success of newly established plants.

For the major groups of vascular plants (trees, shrubs, herbs, and grasses), the post-fire plant community, at least for the first few years following the fire, is comprised of species that have the following regeneration strategies:

- plants that survived the fire;
- plants that produced sprouts or suckers from the base or from protected aerial reproductive structures; or
- plants that established from seed (Miller, 2000).

Seedlings that establish on a burned site are derived from one of the following sources:

- seed was dispersed from plants that survived the fire (usually trees);
- seed was dispersed onto the site from adjacent unburned areas;
- seeds that were in the soil seed bank that were stimulated to germinate by the fire; or
- seeds that came from plants within the fire that resprouted following the fire (Miller, 2000).

Types of Effects From Prescribed Burning

Prescribed fire can result in direct mortality, can damage plants or seeds, and can change plant community structure and species composition. The primary difference, however, between unplanned wildland fire and prescribed fire is that prescribed fires are conducted under a rigid set of prescriptive parameters including air temperature, fuel moisture, wind speed, etc. Prescribed fire planners and managers, therefore, exercise careful control over when and where the burns occur, and site-specific prescriptions are developed to meet set objectives relative to vegetation.

The impacts associated with line construction, holding, monitoring, and mop-up of prescribed fires would be similar to those described in the following section for suppression of unplanned wildland fire. These impacts, however, would be less substantial with prescribed fire because they would be carefully planned to minimize impacts, and they would be implemented under controlled conditions.

Types of Effects from Wildland Fires and Suppression

The direct effects of unplanned wildland fires on vegetation can be substantial, including long-term, possibly permanent changes in plant species composition or percent cover, and the introduction or spread of non-native invasive plant species. However, in burned areas with a high component of surviving trees and resprouting native understory vegetation, within a few years it can be difficult to determine that a fire recently occurred (Miller, 2000).

Activities associated with suppression of wildland fire can kill or damage native vegetation. These activities include construction of fire control lines, firebreaks, or access roads; aerial drops of water or retardant; and post-suppression mop up.

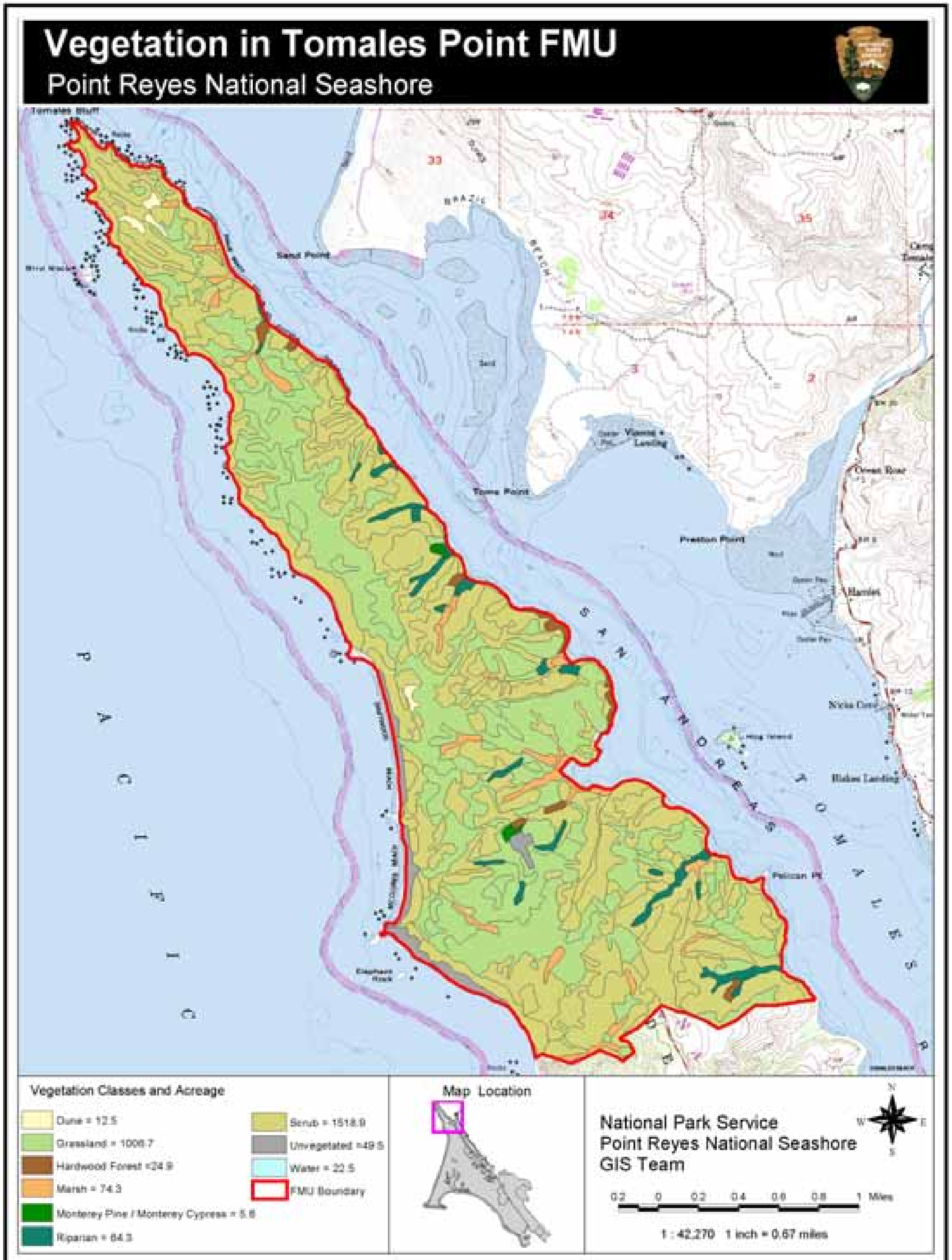
Aerial drops of water or retardant release liquids onto burning or unburned areas. Most fire retardant contains fertilizer type compounds, including ammonia, nitrogen, and phosphorous that can change vegetation, especially in areas low in nitrate/ammonia type nutrients. Added nutrients can decrease growth of native vegetation and increase the establishment of non-native species that favor higher nutrient levels. Impacts can be mitigated by avoiding use of retardant or by using "clear" retardant that has minimal active nutrients within the mix. Physical damage to vegetation can be avoided by requesting that pilots fly aircraft quickly enough to dissipate water and retardant over larger, more linear areas.

Vegetation that may have survived the fire itself may be adversely affected by mop-up activities through soil disturbance, damage to aboveground plant parts, or uprooting.

Types of Effects From Mechanical Treatment

Generally, the impacts of mechanical treatments include direct mortality or damage to individual plants, the introduction or spread of non-native plants, and trampling or burial of plants. Mowing occasionally kills plants, but also can stimulate growth of grasses. Adverse impacts could occur if the mowing stimulated growth or spread of invasive non-native plant species. Piles of cut vegetation may be burned following hand thinning. Impacts associated with pile burning include soil disturbance associated with dragging materials to each pile; localized, intense burn effects upon surface fuels, litter and duff, and soil layers; and long lasting effects on soil chemistry and structure due to extreme heating over long time periods. Pile burning can result in extremely hot temperatures in localized areas, which can kill aboveground vegetation, roots, and seeds in the soil. These superheated areas also may be subject to invasion by non-native plant species.

Figure 17. Vegetation in Tomales Point FMU



Plot date: December 2, 2002 s:\gis\projects1\fire\fmp\plant_communities\pore_comm.apr

Figure 18. Vegetation in the Headlands FMU

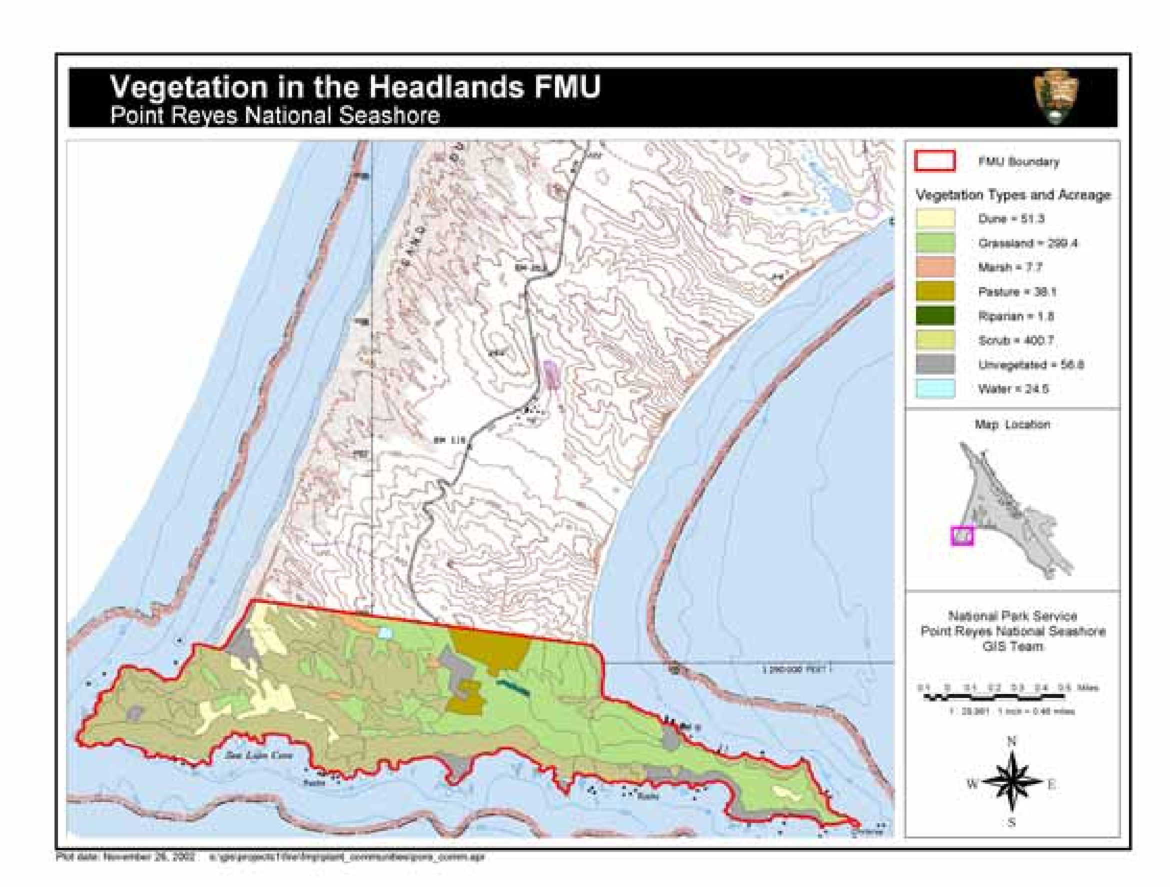


Figure 19. Vegetation in the Estero FMU

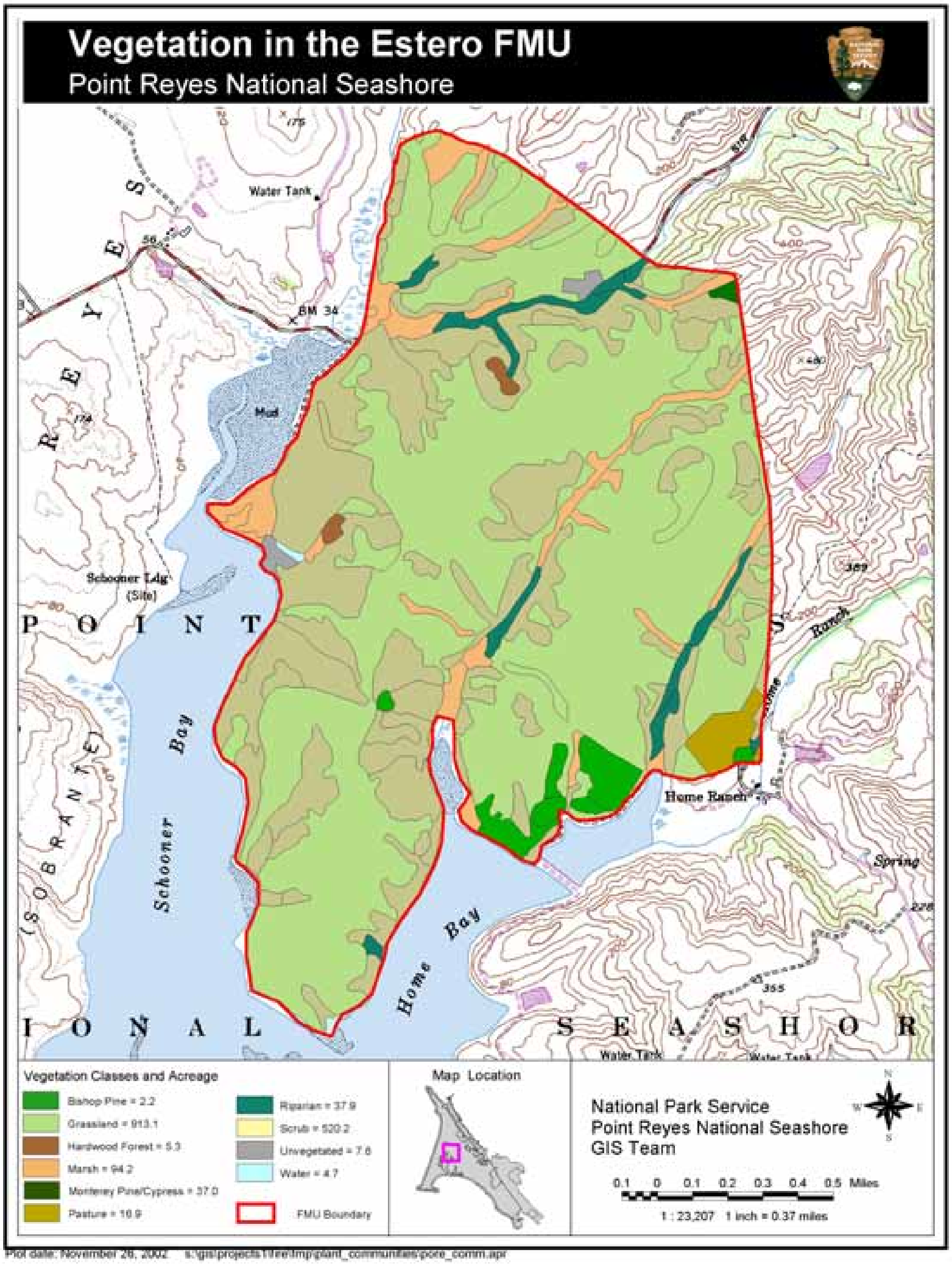


Figure 20. Vegetation in Inverness Ridge FMU

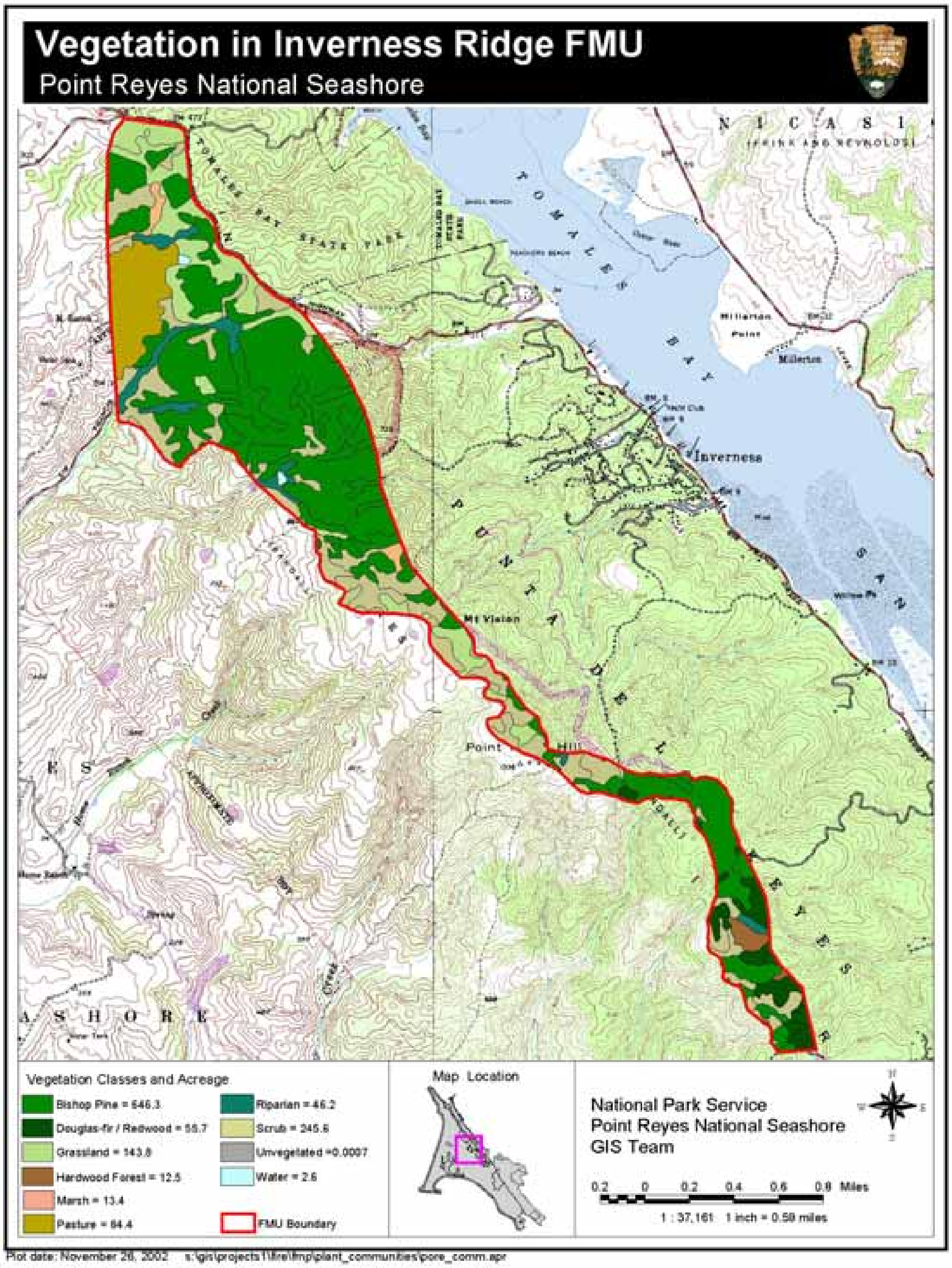


Figure 21. Vegetation in the Limantour Road FMU

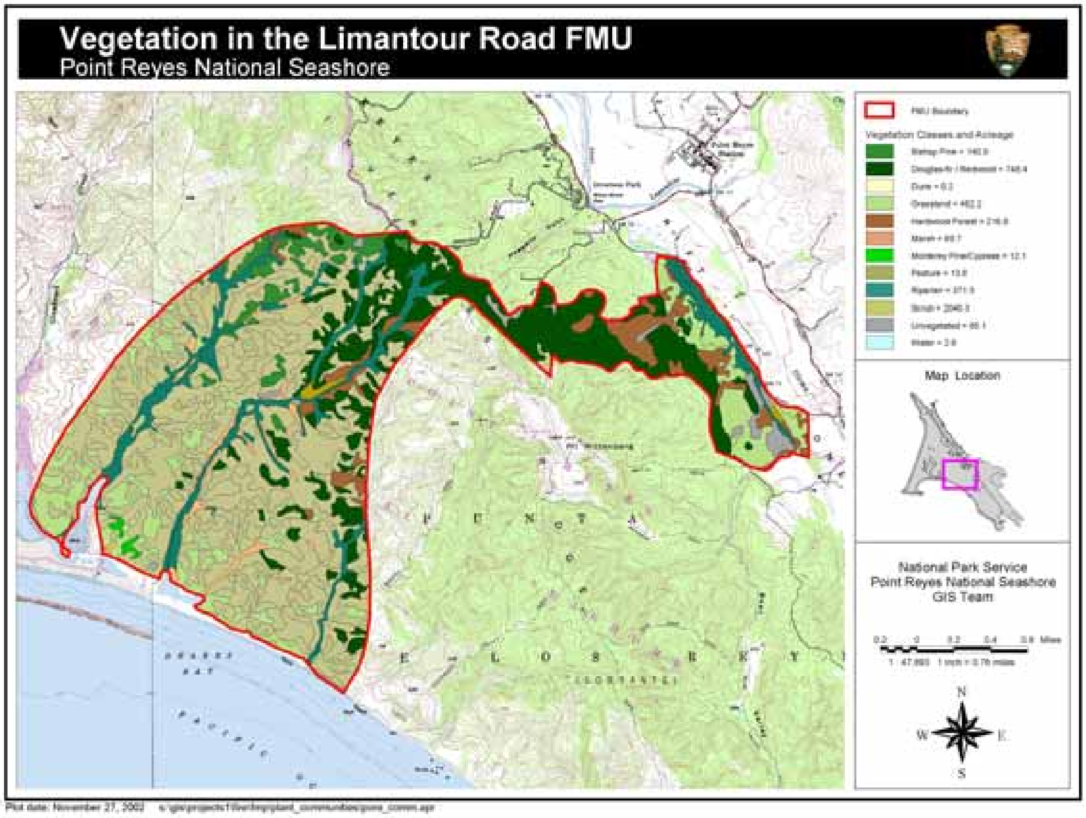


Figure 22. Vegetation in Wilderness North FMU

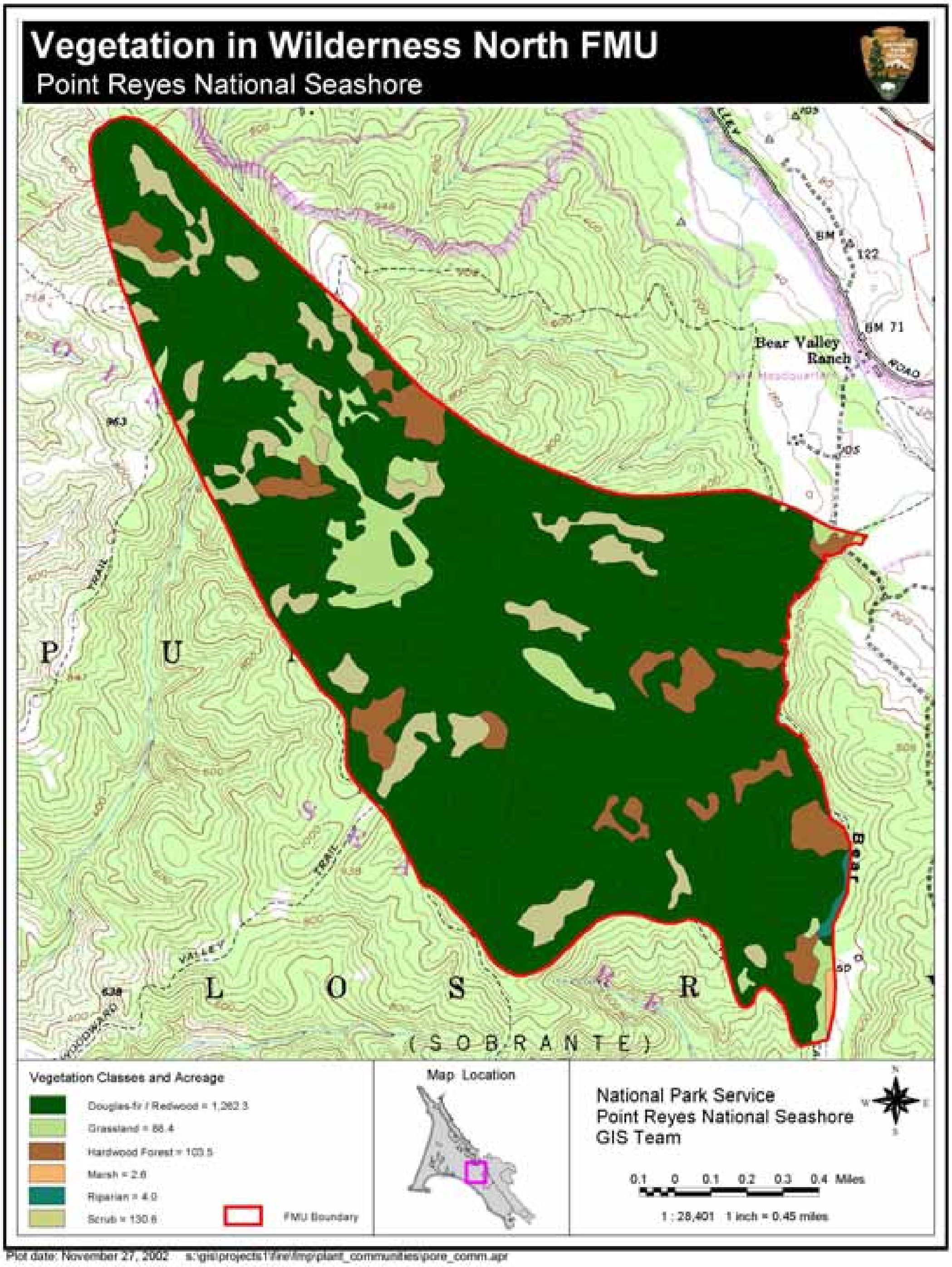


Figure 23. Vegetation in Wilderness South FMU

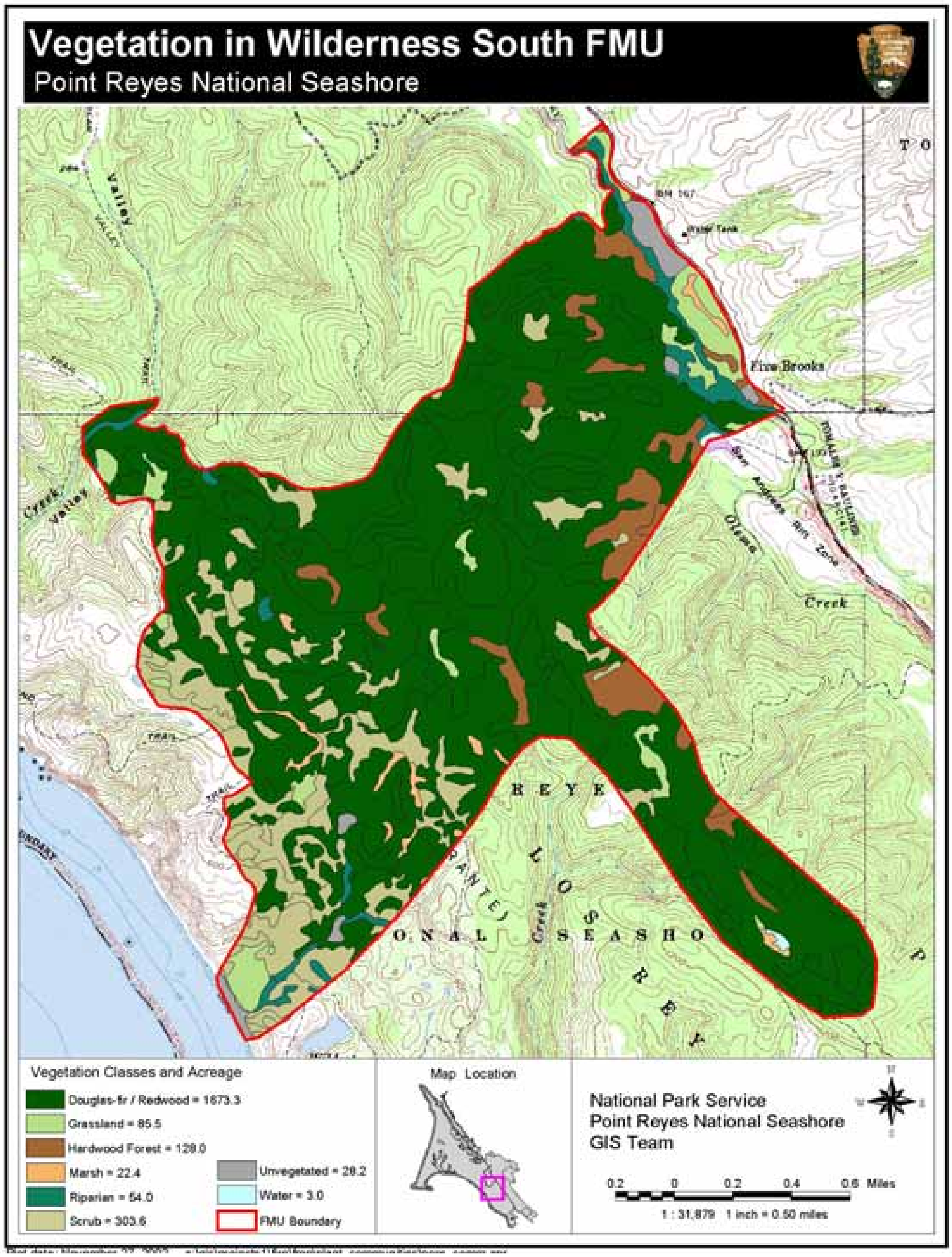


Figure 24. Vegetation in Highway One FMU

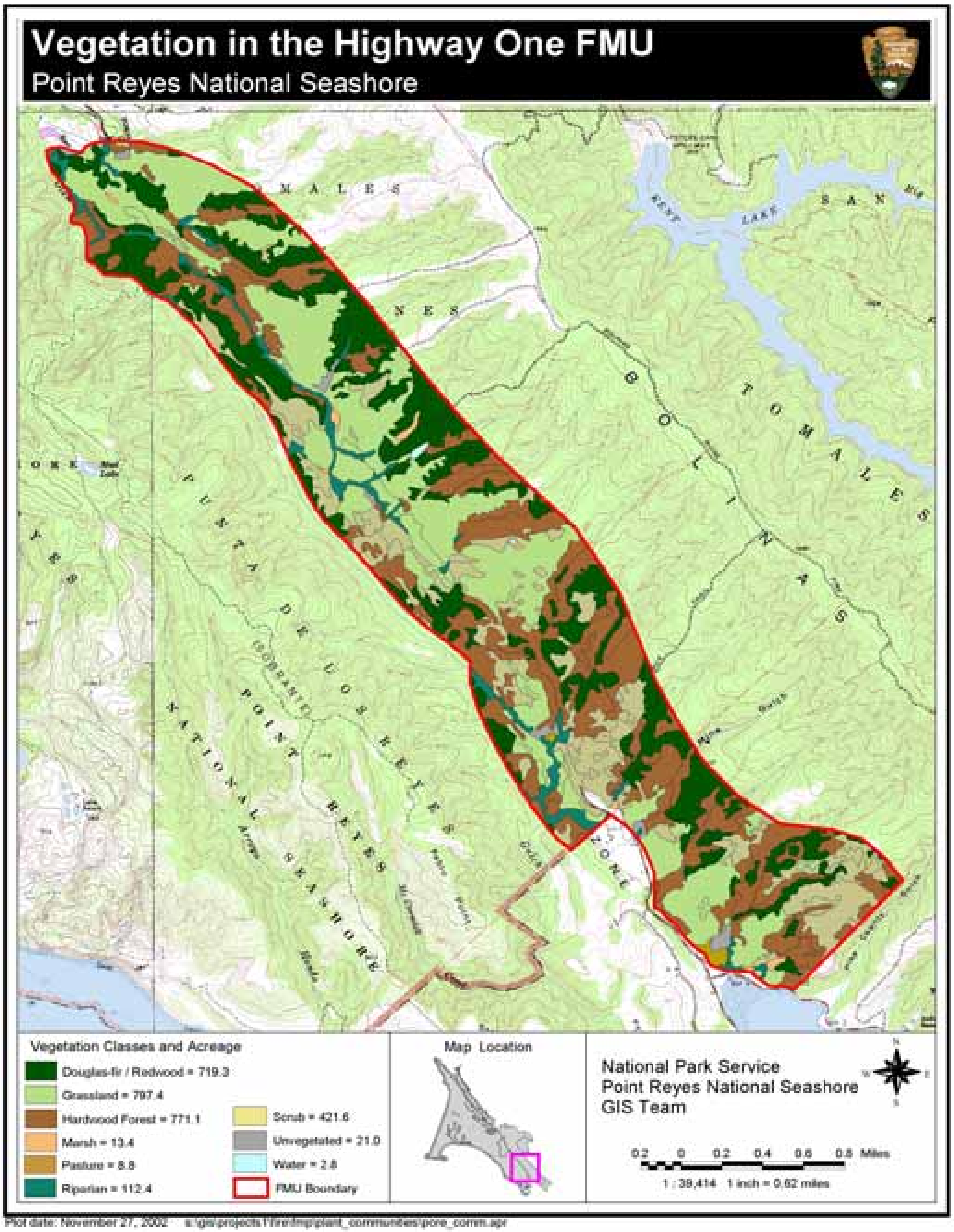


Figure 25. Vegetation in Bolinas Ridge FMU

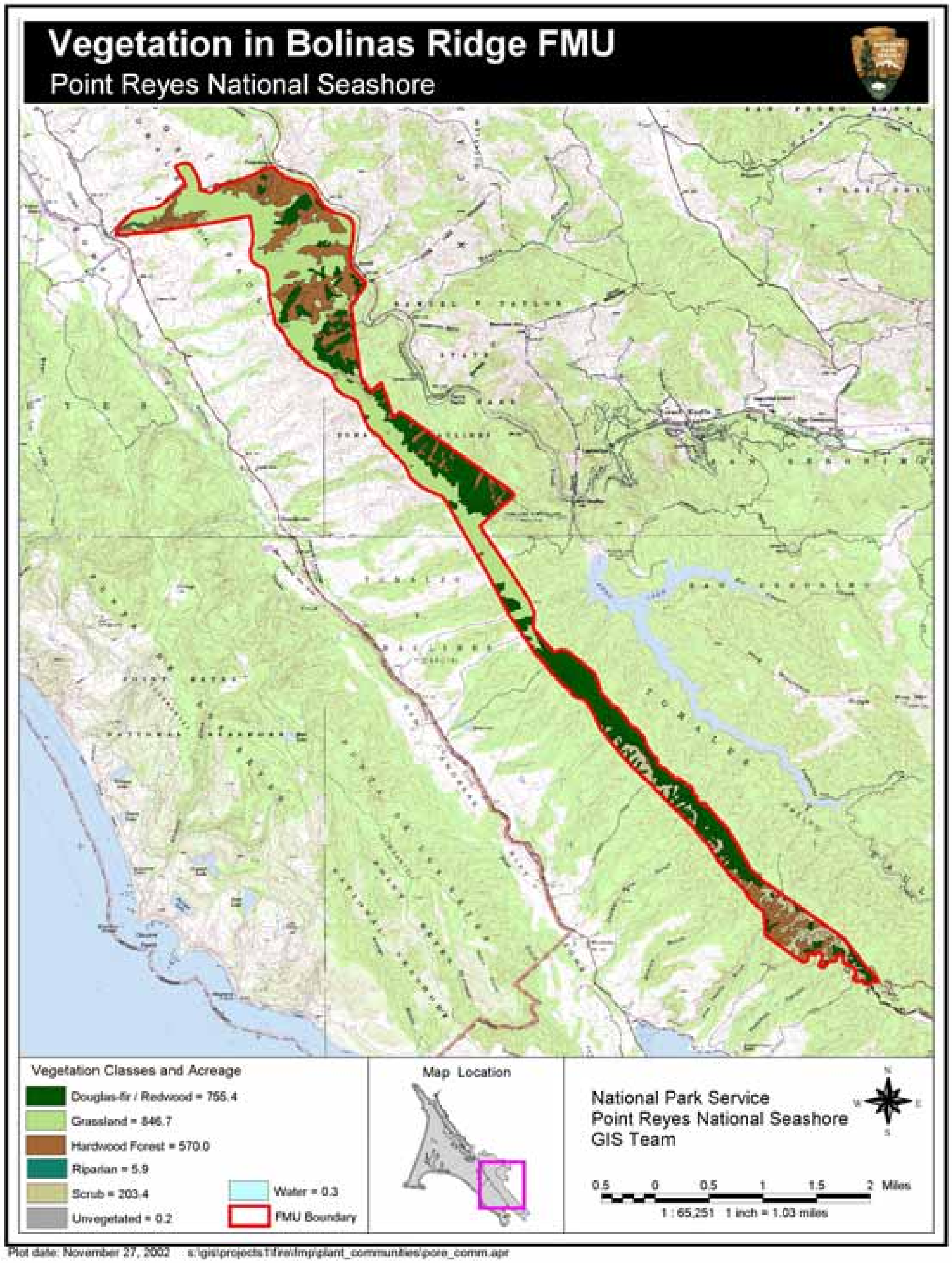
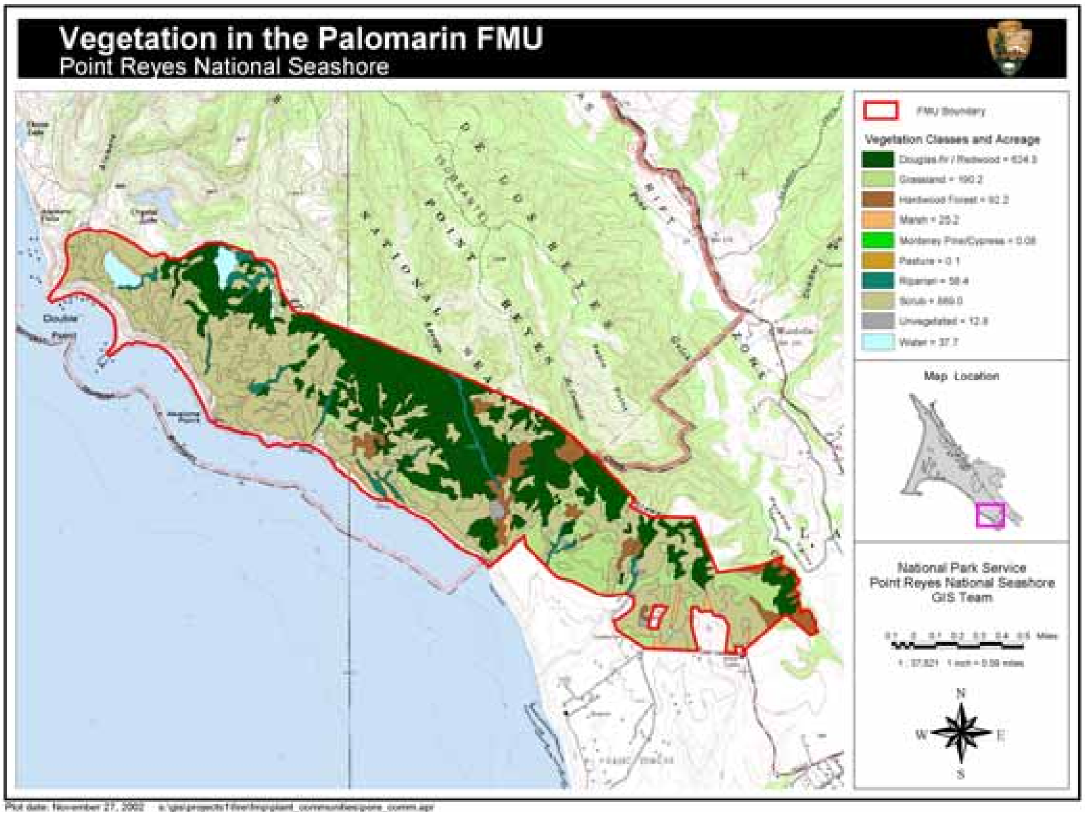


Figure 26. Vegetation in the Palomarin FMU



Alternative A

Analysis

Prescribed Fire

The FMUs that would be treated with prescribed fire in this alternative include Estero, Limantour Road, Highway One, and Bolinas Ridge. As noted in the Alternatives section of this EIS, the primary focus of treatment would be to manage hazardous fuels along primary roads and reduce the aerial extent and density of non-native invasive plant species, including Scotch broom, French broom, and Monterey pine. The impact analysis for fire management activities and cumulative impacts is discussed by vegetation type to follow the subsections of Affected Environment.

Bishop Pine Forest
Although Bishop pine forest occurs in Limantour Road FMU, it would not be treated with prescribed fire in this alternative.

Douglas-fir/Coast Redwood Forest
This vegetation type occurs in three of four FMUs slated for treatment in Alternative A, but because of the more narrow focus and fewer acres treated, would not be burned with prescribed fire.

Hardwood Forest
Hardwood forests occur in all FMUs except Headlands and would, therefore, be affected by fire management activities in all Alternatives. Limited prescribed burning could be conducted in small areas supporting hardwood forest in Alternative A, but this would occur only where such forest borders grasslands, Scotch or French broom stands, Monterey pine stands, or research plots as described in the Alternatives section of this document. Therefore the analysis of fire effects on species dominant in hardwood forests is covered under Alternatives B and C, where fire would be used to reduce fuels in this vegetation type. Prescribed burning may have negligible beneficial long-term impacts to these forests resulting from improved forest health.

Monterey Pine/Monterey Cypress
These trees occur as stands and as individuals throughout the Seashore. Although severe surface or crown fires only kill Monterey pine adults, young trees are thin-barked and can be killed with prescribed burning. Monterey pine cones are serotinous; seeds are released when cones are exposed to heat such as fire or high air temperature. Fire is particularly effective for opening cones and releasing seeds and it creates a favorable seedbed. Reproduction rates are greatest after surface fire in which the parent trees survive. In this alternative, the density and extent of stands of Monterey pine in Estero and Limantour Road FMUs would be managed in part through controlled burning. Prescriptions would be carefully controlled to kill young trees without creating conditions under which reproduction rates for remaining adults would increase.

Monterey pine and Monterey cypress were introduced into the project area as ornamentals and to provide windbreaks. Because the NPS seeks to eliminate non-native species and restore vegetation communities to a natural state, removal of individual trees in Estero and Limantour Road would have a localized minor to moderate long-term beneficial impact to native vegetation. For these beneficial impacts to persist, however, follow-up activities must be conducted to remove new recruits that come into the site in years following prescribed burning or mechanical treatments. Adverse, minor, short- to long-term impacts also could occur as a result of application of fire management activities if other non-native invasive plant species invade or spread on treated sites.

<u>Mitigation Measures</u>
Follow-up non-native plant monitoring and removal would be conducted to remove new recruits that come into the site in years following prescribed burning or mechanical treatments.

Riparian Woodland
Riparian vegetation occurs alongside rivers, streams, and creeks. In Point Reyes, riparian woodlands and shrublands would not be treated with either prescribed fire or mechanical means, and a 100-foot buffer would be maintained if fire management activities were to occur in the vicinity. Riparian vegetation could be burned by wildfires and potential impacts are discussed in Cumulative impacts below.

Coastal Scrub
Prescribed fire would be used to continue efforts to reduce the extent and density of non-native invasive plants Scotch broom and French broom, which are common inhabitants of both grasslands and coastal scrub (see Table 50). Prescribed fire would be used in both Estero and Highway One to control this invasive species.

Table 50. Broom Acreage within Fire Management Units

Fire Management Unit	Alternative A	Alternative B	Alternative C
Tomales Point Headlands Estero Inverness Ridge Limantour Road	1,436	1,436	1,436
Wilderness North Wilderness South Highway One Bolinas Ridge Palomarin	988	988	988
Totals	**2,424**	**2,424**	**2,424**

Earlier work reported in the park's 1993 Fire Management Plan (PRNS, 1993) indicated the temperature attained during a prescribed burn was important in killing seeds of both species of broom. Heat greater than 150 degrees C for more than two minutes killed the majority of the Scotch broom seed and those greater than 100 degrees C for one minute increased susceptibility of this species to fungal pathogens. However, temperatures of less than 65 degrees C for two minutes significantly increased germination. French broom seeds are killed when soil temperatures reach 125 degrees C for one minute. Effective control appears to involve a combination of cutting at the end of the dry season to decrease the rate of resprouting, and a fall or spring burn repeated every year for several years. This is the approach the park has been using for Scotch broom. Preliminary monitoring has indicated the combination of cutting or mowing followed by prescribed burning has reduced the extent of Scotch broom shrubs on average by 84% since 1990 (PRNS, 2002a), a potential moderate benefit if applied throughout the range of this species. Fire management activities have not been as successful with French broom, as preliminary monitoring indicates what may be an increase in the frequency of this species in plots that have been mechanical treated and then burned. However, unlike Scotch broom, treatment regimes for French broom have been inconsistent across study plots and data do not reveal a statistically significant trend. Graphing the existing data show mechanical treatment followed by prescribed fire may be an effective means of exhausting the seed bank, although it remains to be seen if subsequent burns would reduce shrub frequencies to levels where mechanical removal of individual remaining shrubs would be feasible (PRNS, 2002a). Based on the information PRNS has to date, overall treatments would have a long-term moderate beneficial effect on vegetation.

Grassland

Prescribed burns and mechanical treatments would occur in grasslands in four FMUs under Alternative A. Treatments would occur primarily along road edges, and around structures to reduce fire hazard. Impacts of these activities on vegetation are expected to be adverse, negligible to minor, and short- to long-term if non-native species expand in density or aerial extent as a result of treatments.

Dominant non-native plant species in grasslands in the project area include velvet grass, annual wild rye, perennial ryegrass, small fescue, foxtail fescue, and Farmer’s foxtail. Dominant native grass species include tufted hairgrass, California brome, Pacific reedgrass, California oatgrass, and meadow barley. Monitoring results and other, published, information indicate annual wild rye adults are likely killed by fire, although their seeds may survive. The remainder of the dominant non-native species of grasses at the Seashore either are largely undamaged by prescribed fire, or appear to be stimulated by it. This is because seeds are either buried and unaffected by all but very hot fires, or the plant sprouts from buried structures, such as rhizomes or root crown in the growing season following the burn. As noted in Affected Environment, roughly 80% of the grasslands at the Seashore are dominated by non-native grass species.

In keeping with NPS and Seashore objectives to reduce the aerial extent of non-native species and encourage natives, prescribed fire has been used in combination with mowing, grazing, seeding, and/or herbicides with varying degrees of success to try to shift the balance. A recent meta-analysis (Twedt, 2003) of such attempts did not identify any strategy that consistently favored native species relative to non-native species. Rather, the outcomes were very case- and site-specific. For example, while a combination of prescribed fire and mowing has been successful in removing scotch broom from some grassland communities, prescribed burning of the high invasive purple velvet grass may be increasing its abundance.

The results of monitoring more than a decade of fire management efforts at the park remain preliminary, and additional control plots and data need to be gathered before a particular management approach for each vegetation type can be linked to a conclusive result; however these initial results show prescribed burning can result in an increase in non-native species as easily as a decrease. As part of this plan (and as noted in Mitigation sections), the effects of all prescribed burning carried out on grasslands would be carefully monitored to assess post-burn plant species cover and composition. If monitoring shows prescribed burning is definitively linked to an increase in non-native plant cover or distribution, either the prescription would change (e.g., burn during different seasons), it would be combined with other treatments (such as mowing, seeding of natives, etc.), or another strategy would be employed to restore native grassland vegetation.

Mitigation Measures

All grassland burns would be carefully monitored to ensure burn objectives (= recruitment and long-term maintenance of native species without introduction of invasive non-native plant species) are being met.

To enhance grassland plant species composition, and reduce the chance of invasion or spread of non-native species, native seeding trials would be conducted following fire management treatments in some areas.

Pasture

The majority of pasture is within the Minimum Management Unit, and is used to graze cattle or horses or managed to produce silage for cattle. In the FMUs slated for treatment with prescribed fire in this alternative, all but Bolinas Ridge have small amounts of pasture. In general, no fire management activities are planned for these areas, except clearing of vegetation around structures and clearing along roads and fire roads. However, small areas of non-native species, including Scotch broom, French broom, or Monterey pine in pasture vegetation may be burned or mowed to reduce the density and aerial extent of these invasive species. Impacts associated with these efforts would be beneficial, minor to moderate, and long-term as a result of removal of invasive non-native plants. For these beneficial impacts to persist, however, follow-up activities must be conducted to remove new recruits that come into the sites in years following prescribed burning or mechanical treatments. Because results vary when prescribed fire is used to treat non-native invasive species, some unexpected spread of a particular population may also occur. If so, this would result in adverse, minor, short- to long-term impacts.

Coastal Dune

No coastal dune vegetation occurs in the FMUs that would be treated with prescribed fire in this alternative.

Unplanned Ignitions, Wildland Fire, and Suppression

The average number of unplanned ignitions at Point Reyes has been three fires annually, with each of these fires burning less than ten acres. The actual extent and magnitude of impacts are impossible to predict, however, as these fires are unplanned. Information on direct effects would, in most cases, be obtained after the fire, and would involve documenting effects on resources for which little pre-burn data were available. All of these impacts would be mitigated following a fire with assistance from the NPS Burned Area Emergency Rehabilitation (BAER) program.

The impacts on vegetation associated with these small, unplanned wildfires and their suppression are expected to be both adverse and beneficial. Adverse impacts are expected to be minor and short-term, and result from the loss of individuals of native species through mortality or decreases in reproductive ability. It is possible that small invasions of non-native plants would result from these fires, which could result in a longer-term impact, but the impact would be localized. Small unplanned wildland fires in the project area may have some beneficial impact on vegetation in localized areas if non-native plants are killed, and native plants establish on the site following the fire.

Suppression activities would also have direct but localized impacts. Fire control lines involve clearing all vegetation within an 18 to 24 inch-wide swath down to bare mineral soil. In grassland habitat, a weed whacker, mower, or tractor may be used. In shrub or forested habitats the vegetation is cut and the fireline is cleared using chainsaws, shovels, Pulaskis, and McLeods. Fire line construction also can include cutting brush, limbing trees, and cutting snags. Inward 10 to 20 feet from the fire's perimeter line, vegetation density (and consequently fire intensity) is reduced by cutting down all trees and cutting shrubs to a 15 to 20-foot wide separation using chainsaws, shovels, Pulaskis, and McLeods. In emergency situations, bulldozers are used to create fuel breaks to stop wildfire. Vegetation clearing can create conditions that are favorable for the establishment of non-native plant species.

Aerial drops of water or retardant release liquids onto burning or unburned areas. Vegetation can be physically damaged from the impact of the liquid, but the areas affected tend to be small and the effects relatively local. Although the chemical components of retardant only remain for a few months at most, and long-term, chemical alteration of the soil would not occur, there could be localized long-term impacts to areas if non-native plants become established or spread.

Fire suppression activities may require development and use of helispots and spike camps, which could disturb vegetation. In forested areas, trees and/or snags may be removed to open areas for safe operation of aircraft or to make camps safe for fire personnel. These impacts generally are local. Aircraft skids or wheels, boots, equipment, and camp and base supplies could be contaminated with non-native seed, providing vectors for non-native species that would not otherwise disperse to these sites.

Post-suppression mop-up involves digging, cutting, trenching (to prevent debris from rolling), chinking (taking a pulaski and clearing burning material off a log), chunking (putting smoldering material into one pile and letting it burn up), and mixing dirt with water from backpack pumps or from hoses. Any smoldering that is causing nuisance smoke is extinguished.

Mitigation Measures

Adverse impacts to vegetation would be mitigated to the greatest extent possible during all fire management activities using the following measures:

Pre-Treatment Measures

Individual prescribed burns would be conducted within the framework of a multidisciplinary planning effort. Personnel from fire management and from resources management would work together to identify areas that are expected to benefit from prescribed burning. Existing data on the response of plant communities in the Seashore to fire would be consolidated and analyzed to determine optimal areas, configurations, and times for burns. Clear objectives would be developed for prescribed burns that would include measurable parameters to determine the effects of the burns on vegetation. Following burns, vegetation would be analyzed to determine the effects of the burn, which would aid in future burn planning.

Impacts associated with all fire management treatments would be minimized through pre-project planning and coordination with vegetation managers within the Resource Management Division.

Prescribed burns would be conducted at a time of year when introduction or spread of non-native plants would be minimized, and mortality of non-native plant species would be maximized.

Whenever possible, existing roads or trails would be used as firebreaks for prescribed burns and for wildland fire suppression.

Prescribed burns would be planned to minimize adverse impacts to vegetation to the greatest extent possible (e.g., in areas supporting invasive non-native plants, spring burns may be less likely to result in spread of the non-natives and should be considered; in these cases, however, other factors also must be considered such as whether or not spring burning would adversely affect soil seed of native plant species).

Vegetation managers would work with fire management staff to develop maps of areas that support plant communities of special management concern (e.g., uncommon communities, wetlands, riparian areas, dunes, areas with no non-native plants that need to be kept intact, areas with highly invasive non-native plants that should not be spread) so fire personnel can attempt to avoid such areas when making decisions about fire management tactics.

During Treatment Measures

Soil disturbance would be minimized to the greatest extent possible to reduce potential for introduction or spread of invasive non-native plant species.

The aerial extent of disturbance associated with mechanical treatments would be kept to the minimum necessary to reduce fire risk.

Known populations of special-status plant species would be avoided when locating helispots or spike camps.

Previously disturbed sites and open areas would be used for helispots or spike camps whenever possible to minimize additional disturbance.

Burn piles would be kept small to minimize the area disturbed and to allow for the recolonization of sterilized patches by mycorrhizal fungi and other soil organisms in adjacent areas.

Post-Treatment Measures

Areas subject to fire management treatments would be monitored periodically for the presence of invasive non-native plant species, and if such species have established or spread as a result of such activities, the non-natives would be removed.

All fireline (both handline and dozer line) would be rehabilitated as quickly as possible, which includes application of Burned Area Emergency Rehabilitation (BAER) techniques such as recontouring, soil stabilization as needed, and monitoring for and removal of invasive non-native plant species for a minimum of three years following a fire.

Litter and duff would be replaced on disturbed sites to make them less susceptible to invasion by non-native species.

Post-treatment surveys for non-native plants would be conducted in areas subject to mechanical treatments, and measures to remove non-native species in disturbed areas would be undertaken.

Mechanical Treatment

Up to 500 acres of vegetation would be mechanically treated in Estero, Limantour Road, and Highway One FMUs in Alternative A. The focus of treatment would be mowing grasslands to reduce hazardous fuels and control Scotch and French broom, and cutting Monterey pine to help eliminate this non-native species.

Vegetation would be mowed around structures and along roads to reduce fire hazard, and, in some cases, around the perimeter of a planned prescribed burn to contain the burn. Mowing occasionally kills plants, but also can stimulates growth of grasses. Adverse impacts could occur if the mowing stimulated growth or spread of invasive non-native plant species. Mowing has been used to some degree of success in helping control the spread of scotch broom (see coastal scrub, below). This would continue in Alternative A.

In the past, cutting and thinning of vegetation has been conducted in small, developed areas of the Seashore, primarily around structures and along roads. Under this alternative, thinning would continue in these areas to remove small diameter trees and brush to reduce the risk of unplanned ignitions, to safeguard structures, and to make travel on roadways safer in the event of an unplanned wildfire. Some soil disturbance would occur during this work and there would be a potential for non-native plant species establishment or spread. The minimum requirement for defensible space along roadways is 10 feet on each side.

For clearing along roads, trees along the sides of the roadways are limbed up to 10 feet in height as needed. Native tree species commonly subject to limbing include Douglas-fir and Bishop pine. Trees less than four inches in diameter (dbh) are removed from a corridor 10 - 15 feet wide on each side of the road (measured from the edge of the roadway). This width can increase to 20 feet wide where roads cross topographic saddles. Downed trees in or near the roads are cleared. Grass growing up within roads is cut or mowed.

Defensible space required at each structure is based on individual site topography, and usually ranges from 30 - 50 feet around structures. In some cases, a larger cleared area may be required to protect the structure from potential fire hazard due to prevailing winds or the presence of drainages or swales close to the structure. For defensible space large trees are pruned or removed if the tree poses a threat, grasses are cut to stubble, and smaller trees are pruned or removed based on individual site topography. The health of all trees within the defensible space is assessed and any dead and dying trees are removed.

Piles of cut vegetation may be burned following hand thinning. Impacts associated with pile burning include soil disturbance associated with dragging materials to each pile; localized, intense burn effects upon surface fuels, litter and duff, and soil layers; and long lasting effects on soil chemistry and structure due to extreme heating over long time periods. Pile burning can result in extremely hot temperatures in localized areas, which can kill aboveground vegetation, roots, and seeds in the soil. These superheated areas also may be subject to invasion by non-native plant species.

Bishop pine, Douglas-fir, and Hardwood forests
Under Alternative A, impacts from mechanical treatment to forest vegetation, including bishop pine, Douglas-fir, and hardwood forests, would come from the thinning and fuel reduction activities described above. These impacts would be adverse, negligible to minor, and short-term (potentially long-term if non-natives are introduced or spread).

Monterey Pine/Monterey Cypress
Monterey pine and Monterey cypress were introduced into the project area as ornamentals and to provide windbreaks. Because the NPS seeks to eliminate non-native species and restore vegetation communities to a natural state, removal of individual Monterey pine trees in Estero and Limantour Road would have a localized minor to moderate long-term beneficial impact to native vegetation. For these beneficial impacts to persist, however, follow-up activities must be conducted to remove new recruits that come into the site in years following mechanical treatments.

Mitigation Measures

Follow-up non-native plant monitoring and removal would be conducted to remove new recruits that come into the site in years following prescribed burning or mechanical treatments.

Riparian Woodland
No mechanical treatment would occur in riparian woodland in any alternative.

Coastal Scrub
Under Alternative A, mechanical means would be used in coastal scrub in areas that require treatment around structures or along roads or fire roads. Adverse negligible to minor short-term

impacts could result. In addition, mowing to target both Scotch and French broom in Limantour and Highway One FMUs would continue (see discussion of prescribed burning in coastal scrub above), with possible moderate benefits to native coastal scrub species.

Grassland
Scotch and French broom also occur in grasslands in the above mentioned FMUs, where mechanical treatment by mowing would be used to help control the spread of these species.

Pasture
As noted above, treatment would generally not occur in pasture, although some mowing of Scotch and French broom is possible.

Coastal Dune
No coastal dune vegetation occurs in the FMUs that would be mechanically treated in this alternative.

Fire Information/Education

This would have no beneficial or adverse effects on vegetation.

Fire Cache/Park Headquarters Relocation and Construction

The construction of a fire cache at Bear Valley would not have a beneficial or negative impact on vegetation. The building would be located at least 100 feet from riparian zones and temporary construction plastic fencing would be used to eliminate any impacts to this vegetation zone. In addition, the site is a former trailer pad and nearly unvegetated.

Fire Effects and Fuel Management Research

Research burns would continue on velvet grass and Scotch and French broom to help Seashore ecologists refine burning prescription parameters to control these species. This could have substantial benefits to the park's natural coastal scrub and grassland communities in Estero and Highway One FMUs, as well as to these communities both within the entire study area and in the region where these species are currently invading. Alternative A does not include any research or test plots in other vegetation communities, or to test other factors in grasslands and coastal scrub. To the extent that no additional research is conducted, fire-dependent native vegetation would continue to decline.

Cumulative Impacts

Perhaps primary among the combination of factors influencing vegetation at Point Reyes is the century of fire suppression beginning in the late 1800s. Evidence from tree rings show periodic fire (ranging from every 6 to perhaps as long as 30 years) in the project area is a natural occurrence, and several native species in the project area reproduce abundantly only following fire. Suppression of periodic fire has favored fire-intolerant species, non-native species and allowed the unnatural buildup of both dead and live fuels. Shrub and grassland habitats for example, are experiencing encroachment by fire intolerant conifers. Native Marin manzanita populations are becoming rare as a result of shading from increasing forest stand density. As noted in other locations in this EIS (see Fire History, for example) the build up of fuels, or change from understory (grasses and forbs) dominance to overstory (trees and shrubs) dominance, and changes in forest structure generally increases the risk of a large-scale wildfire, which can affect vegetation in the extreme by completing replacing existing vegetation (Covington et al., 1994). In some cases, replaced vegetation would not return; in others, a climax seral stage may return after many years.

Logging, grazing and development of land in the region have also contributed to changes in composition and density of key species. For example redwood forest is estimated to have covered 1,976, 000 acres.150 years ago. Today, approximately 1,570,000 acres is left, and only 11% of that is protected park land (Jensen, 1993). Analysis of pollen from coast live oak (the dominant tree of the park's hardwood forests) show that oak woodlands were stable for up to four centuries before major European-American settlement. Fire suppression efforts beginning in 1870 and extending into recent years resulted in a two-fold increase in oak pollen and oak density. Today, recruitment of most oaks in California has declined, with some species not regenerating rapidly enough to maintain current density (Jensen, 1993). Monterey pine, Monterey cypress, and eucalyptus have all been imported by European-American settlers for lumber or other reasons. Eucalyptus in particular has been a prolific "weed tree" over much of California. Coastal sage scrub is present in about 15% of its former habitat, primarily because of agricultural, industrial, and residential development. Grasslands in California have been invaded by exotic species in part because of the displacement of native elk by domestic livestock, the introduction of exotic plant species adapted to livestock grazing and the clearing and plowing of land for agriculture (PRNS, 1993). Scotch and French broom are escaped ornamental shrubs brought from Europe and velvet grass is imported from Eurasia. All are highly invasive species that occur in grasslands and coastal scrub in the study area. In the immediate study area, the projects cited in Appendix C have removed some vegetation, and park needs may continue to result in minor impacts to vegetation from removal, or from disturbance that allows non-native invasive species to take hold in some localized areas.

Fuel build-up from a century of fire suppression increases the potential that a large crown fire could occur. In Alternative A, the treatment of 500 acres through mechanical means or prescribed fire would do little to reduce the risk of such a fire. These larger fires could result in establishment and spread of non-native plants, or habitat type conversion. Activities to suppress large wildland fires would be the same as those described above in the Unplanned Ignitions section and could have substantial, although localized, impacts on vegetation if extensive areas are treated with retardant, or if extensive dozerline is constructed. The actual extent and magnitude of impacts are impossible to predict, as these fires are unplanned. However, a large-scale fire similar to the Vision Fire could have major adverse and potentially long-term effects on some native park vegetation communities. In others, such as Bishop pine, wildfires may actually stimulate reproduction and increase density, with resulting long-term positive impacts.

Bishop pine

Fire plays an important ecological role in maintaining Bishop pine forests. Stands of Bishop pine are characteristically even-aged, originating after fires, and their cones persist for many years, usually opening as a result of fire. Bishop pine stands are often dense, and stand-replacing crown fire typically occurs in such stands.

A recent vegetation mapping project, conducted from 1996 through 2001, revealed approximately 3,570 acres of Bishop pine forest occurring within Seashore boundaries. In 1995, approximately 35% (1,250 acres) of this acreage was burned in the Vision Fire. Following the fire, most of the pines in the area were dead and the formerly deep litter layer had been burned away. The bare, charred soil was covered with extremely large numbers of Bishop pine seeds. Regeneration in the burned area has been prolific, with dense stands of young Bishop pine growing up to replace the burned forests. One year following the fire, large dense patches of Bishop pine had recolonized the burned area. This suggests that the increased risk of a crown fire at the Seashore would have a relatively beneficial impact on bishop pine forest.

Douglas-fir/coast redwood forests
In some areas supporting Douglas-fir forest in the Seashore, fuel loads have increased as a result of fire suppression. Vertical separation between surface fuels and the conifer overstory has been eliminated or substantially reduced by the growth and development of a midstory conifer layer. In many areas, duff layers and woody debris have increased while the biomass of the ground vegetation layer has decreased. This increases the potential for crown fire.

Seedling establishment following fire depends on the spacing and number of surviving seed trees. Seedling establishment in stand-destroying fires is slow because seed trees are killed over large areas. Where seed trees are scarce, it may take 100 years or more for Douglas-fir to reoccupy the burned area. Conversely, Douglas-fir can quickly establish seedlings if there are numerous, well-spaced surviving seed trees within the burned area. Mineral soils exposed by fire are generally considered favorable seedbeds.

Hardwood Forest
Both of the dominant species of park hardwood forests, California bay and Coast live oak, are able to survive and/or repopulate following most wildfires. While bay is not protected from even moderately severe fires by virtue of its thin bark, it does resprout from the root crown or bole following fires, a characteristic typical of most California hardwoods. Sprouting in California bay occurs after fire in virtually any season, and reproductive ability is regained quickly; flowers have been noted on first-year sprouts. Seedlings are established the first year, and California bay continues to produce seedlings until the next fire. In the coast redwood forest of Muir Woods National Monument, for example, 567 seedlings per acre were observed at postfire year 134. The dense understory was co dominated by redwood and California bay trees that began as sprouts and seedlings following the 1845 fire.

Adult coast live oaks are more protected from wildfires than California bay. They are evergreens, have thick bark, have roots that are protected from fire by an outer corky layer, and generally recover well from fire. Evergreen leaves allow this species to allocate greater amounts of energy to recovery from fire than to replacing the entire crown annually. Evergreens are often better able to conserve nutrients than deciduous species, and are favored in fire-prone environments.

Coast live oaks sprout from the main trunk and upper crown even after severe burning. When trees are top-killed, they sprout from the root crown. Vigorous sprouting is supported by food reserves stored in the extensive root system. Resprouting from the root crown often occurs during the first two months after being blackened by fire, but some charred trees do not resprout for 2 to 3 years. Prefire crown volume is generally recovered, or nearly so, in about 8 to 10 postfire years.

Coast live oak seedlings and saplings less than three inches in diameter may be top-killed by low- to moderate-severity fire, and severe fire kills trees of this size. Because of vascular cambium protection, mature trees have high fire survival rates, even with crown fire. Trees greater than 6 to 8 inches in diameter resist top-kill. An "extremely hot" crown fire on the San Bernardino National Forest caused only 4% coast live oak mortality. Ninety percent of the oaks less than 3 inches in diameter were top-killed, and 2% were killed. Of trees greater than 6 inches in diameter, the trunks and crowns of all but 5% survived the fire without top-kill (the 5% includes 3% that were top-killed and 2% killed). Generally mortality of coast live oak is greater when there is a considerable shrub understory or when trees are adjacent to chaparral.

Coast live oak generally recovers well from fire, although severely burned crowns, trunks, and root crowns may require several years to sprout. If sprouting occurs within several postfire months, basal sprouts can be 2 to 3 feet tall in 2 years, and crown density can be 80 to 100% of prefire levels within 10 years. The most common fire damage to the trunk is a basal wound resulting in potential cambium death. Wounds less than a few inches in size may eventually heal with no accompanying heart rot, but larger wounds are susceptible to fungal and bacterial pathogens and insect infestation.

Although it is difficult to predict the impacts of unplanned wildland fire in these forest types, such impacts could be beneficial, moderate to major, and long-term.

Monterey pine/Monterey cypress

Monterey pine and cypress adults are killed by severe surface or crown fire. Because the adults would normally be the seed source from which new trees grow, their destruction can effectively eliminate several individuals of a population. Follow-up prescribed burns or removal through mechanical means of any juveniles could mean the eventual elimination of these non-natives from the park, a long-term moderate benefit.

Riparian woodland

Red alder and willow dominate riparian woodlands in Point Reyes. Red alder is an early seral species and quickly invades forest openings, such as those created from fires. Young plants grow quickly, which gives the shade-intolerant red alder a competitive edge over conifers, such as Douglas-fir. Because it is shade intolerant, red alder trees that do not maintain their height in the canopy die, resulting in even-aged stands. After about 25 years, conifers equal red alder height and begin to overtop them, and by about 40 years, Douglas-fir becomes dominant. Few red alder trees remain in these formerly mixed stands past 60 years. As stands develop and trees mature, they prevent other red alder seedlings from becoming established, due to the seedlings' shade intolerance.

Red alder's bark, although thin, is sufficiently fire resistant to protect trees from light surface fires. The foliage and leaf litter do not carry fires well. Red alder stands often lack flammable understory debris and are often on moist sites that burn infrequently. Red alder revegetates burned areas via seed from off-site plants. Fire hazard is generally low in red alder stands and stands may be used as natural firebreaks.

Arroyo willow (*Salix lasiolepis*) resprouts from the root crown or stem base following fire. Generally, willows tend to be prolific seeders, and off-site plants are important as a seed source for revegetating burned areas. Severe fires can completely remove organic soil layers, however, leaving willow roots exposed and charred, thus eliminating basal sprouting. Severe fires probably occur infrequently in the moist habitats occupied by arroyo willow.

Both red alder and arroyo willow are highly adapted to periodic, lower intensity fires, and by virtue of their location near rivers or in moist soils are also somewhat resistant to hotter fires. However, high-severity fires in Point Ryes such as the Vision Fire are characterized by extensive burned areas that may be continuous from ridgeline to slope bottom and include riparian areas. Once the seed stock of red alder, or the root crown or seed source of arroyo and other willows is destroyed from this type of very hot and all consuming fire, reestablishment of vegetation would take several years or longer. In addition, during extreme weather events, debris torrents would potentially scour streams, delaying restoration of the riparian community for even longer. It should be noted that in the spring following the Vision Fire, a burned section of the riparian corridor had alders send out leaves, but by the end of the summer many of those trees had died. By year four following the fire nearly all of the alders burned in the fire had died and fallen. They were being followed up by new sprouts; however, the riparian corridor was far more narrow due to the incised channel. Unplanned wildland fire could have adverse, moderate to major, long-term impacts to vegetation in riparian areas if fuel accumulations are large and fires burn very hot.

Coastal scrub

Wildfires are most detrimental to coyote brush, the dominant shrub of coastal scrub, when high temperatures are present at stem bases. At lower temperatures, or if only the above ground portion of the plant is killed, it can reproduce from seed for by spouting from the root crown. Very hot ground fires, however, girdle and kill root crowns, particularly those less than 1 inch in diameter. This means a crown fire, which may be more likely in scrub where ladder fuels have built up, would leave this dominant relatively unharmed and even stimulate resprouting. A hot ground fire, however, would kill adults (McBride and Heady, 1968). A large-scale fire like the Vision Fire because it was a crown fire coastal scrub vegetation had only minor adverse impacts. Most coastal scrub habitat stimulated resprouting.

Grassland

The grassland fuel complex at Point Reyes has changed considerably since European settlement. Over much of the park, evenly spaced perennial bunchgrasses have been displaced by dense stands of annual grasses. The separation between bunch grasses traditionally kept fires to moderate intensity with low to moderate rates of spread, but the dense stands of non-native annuals burn with greater intensity and more rapid rates of spread. In addition, annual species cure rapidly with the onset of the drought in mid-April resulting in a longer fire season that that which existed prior to European habitation (Greenlee, 1983). A large-scale wildfire in Point Reyes could result in damage to non-native species by killing rhizomes from which they sprout and seeds if soil temperatures are high enough. For example, annual wild rye (*Lolium multiflorum*) decreases on burned sites, and non-native perennial ryegrass (*Lolium perenne*) rhizomes are killed in severe fires. Other non-natives are better adapted to fire; fescues (*Vulpia spp*.) produce abundant seed and drop them early enough in the season that they avoid damage from coastal wildfires. Native dominants, such as tufted hairgrass (*Deschampsia caespitosa*) and California brome (*Bromus carinatus*) appear to able to survive all but the most severe burns and spout from root crowns following a fire. As with prescribed burning, impacts to grassland species from wildfires would likely be variable.

Pasture
Although pasture is essentially grassland, fuel loading is significantly lower because of grazing by cattle. The relative intensity of a wildfire would be lower, and species adapted to cooler ground fires would presumably benefit.

Coastal Dune
Coastal dunes are largely dominated by non-native European beachgrass and iceplant. Although these species are mechanically removed, a wildfire may be helpful in reducing the extent of these populations. The chances of wildfire reaching them are considered low, however.

Conclusion

Limited prescribed burning may have negligible beneficial long-term impacts to hardwood forests resulting from improved forest health. Removal of individual non-native Monterey pine trees in Estero and Limantour Road would have a localized minor to moderate long-term beneficial impact to native vegetation. For these beneficial impacts to persist, however, follow-up activities must be conducted to remove new recruits that come into the site in years following prescribed burning or mechanical treatments. Adverse, minor, short- to long-term impacts also could occur as a result of application of fire management activities if other non-native invasive plant species invade or spread on treated sites. Treatment of non-native Scotch broom has been successful, and may provide minor to moderate benefits to coastal scrub and grassland habitat in Highway One and Estero FMUs if applied throughout the area where it occurs. Prescribed burns and mechanical treatments in grasslands could have beneficial or adverse impacts, as results are highly variable. Monitoring and adaptive management would keep these impacts from becoming more than minor if they are adverse. Treatment of small patches broom and Monterey pine in pastures with mowing and prescribed fire could have moderate benefits if follow up activities are conducted.

Average unplanned wildfires and their suppression could have minor, short-term adverse or beneficial impacts on vegetation. Benefits may result from stimulation of fire dependent native species, or from the destruction of non-natives. Adverse impacts come from the loss of native species, as well as from crushing, removal or other physical impacts of suppression.

Mechanical fuel reduction in Bishop pine, Douglas-fir, and hardwood forests would result in negligible to minor short-term adverse impacts. Localized minor to moderate long-term benefits to native vegetation would result from the mechanical removal of Monterey pine in Estero and Limantour Road FMUs. Moderate to major benefits to coastal scrub, grasslands and pasture from the continued removal of Scotch broom and French broom would result from the combination of mechanical mowing and prescribed burning techniques. The continuation of research and wide application of its results would increase these benefits over a wider geographic area.

Fuel build up and fire suppression continue to increase the chances and likely extent and intensity of a large wildfire under this alternative. In some native vegetation communities, such as Bishop pine or hardwood forest, large-scale fire could be beneficial by eliminating non-native species or otherwise creating conditions favoring the spread of native plants. In others, such as Douglas-fir/coast redwood forests, hot crown fires can destroy the seed source for a large area, making re-establishment difficult. Riparian areas may also experience major adverse impacts from hot fires from the destruction of seed source or root crown. The effect of a wildland fire in coastal scrub or grassland is more complex and less well understood, as some native and non-native species are benefited and some are adversely affected. Overall, the cumulative effects of a large-scale fire and all other activities such as development, historic logging, disease, and the introduction of exotics have and would continue to have major, long-term adverse impacts on native vegetation communities in the park.

No impairment to vegetation would result from this alternative.

Alternative B

Analysis

Prescribed Fire

Alternative B would treat vegetation in eight FMUs with prescribed fire, and would burn twice as many acres as Alternative A. Fire would be used in Inverness Ridge, Wilderness North and South, Bolinas Ridge, and Palomarin FMUs in addition to those identified in Alternative A.

In addition to continuing to use prescribed fire to reduce hazardous fuels along primary roads and to reduce the extent of broom and Monterey pine, Alternative B also would treat sites where fuel accumulations have created unsafe situations, and where reduction of fuel could help firefighters slow or stop the spread of fires in the event of an unplanned ignition, such as along Highway One. Burning would be conducted in the same FMUs for the same reasons as in Alternative A, although significantly more burning in shrublands and grasslands in Limantour Road and Bolinas Ridge FMUs would occur, primarily to reduce fuels.

Bishop Pine Forest
Alternative B includes the use of prescribed burns of less than 30 acres in Bishop pine forest in the Inverness Ridge FMU to determine if such burns effectively reduce understory biomass and dead and downed fuels, and if burning results in invasion by non-native species.

Bishop pine is relatively rare inside the park and in the region. The species occurs as relict stands in California along much of the coastline, on Santa Cruz and Santa Rosa islands, and in isolated populations south to central Baja. As noted above, fire plays an important ecological role in maintaining Bishop pine forests. Stands of Bishop pine are characteristically even-aged, originating after fires, and their cones persist for many years, usually opening as a result of fire. Bishop pine stands are often dense, and stand-replacing crown fire typically occurs in such stands. It is hypothesized that a fire-free period of 80+ years would allow trees to succumb to diseases and die without reproducing.

Of the approximately 3,570 acres of Bishop pine forest in the park, 35% (1,250 acres) burned in the Vision wildfire. Following the fire, most of the pines in the area were dead and the formerly deep litter layer had been burned away. The bare, charred soil was covered with extremely large numbers of Bishop pine seeds. Regeneration in the burned area has been prolific, with dense stands of young Bishop pine growing up to replace the burned forests. One year following the fire, large dense patches of Bishop pine had recolonized the burned area.

Bishop pine burned in the Vision Fire were 26-45 years old. If additional testing finds stands nearing or exceeding 80 years, these sites would be ideal candidates for the pilot prescribed burns described above, as disease would likely otherwise take the adults. Prescribed fire would stimulate reproduction in these areas that would otherwise not take place.

Mitigation Measures

Prescribed burning in Bishop pine stands would occur only if the burns can be conducted under conditions that would result in germination and recruitment of new stands of Bishop pine. Relatively cool fires under moist conditions may not meet this objective.

Initially, prescribed burns in Bishop pine forest habitat would be small and would be carefully monitored to ensure burn objectives (= recruitment and long-term maintenance of Bishop pine and associated native species without introduction of invasive non-native plant species) are being met.

If pilot burns are successful in stimulating reproduction and keeping non-natives from invading, prescribed burning would have a minor long-term benefit to Bishop pine stands in Inverness Ridge FMU under this alternative.

Douglas-fir/Coast Redwood Forest

In this alternative, pilot burns to help managers determine how best to burn Douglas-fir and coast redwood would be conducted in at least three FMUs - Wilderness North, Wilderness South and Palomarin. To date, prescribed burns have not been conducted in any of these three FMUs.

Douglas-fir forests and coast redwood forests are the most common forest type in the project area, with Douglas-fir forest occupying approximately 90% of the forested area. Coast Douglas-fir can stand 250 feet or more and span 5-6 feet in diameter. They can live hundreds of years and are common in old-growth stands. The species is intolerant of shade, and requires fire or other disturbance to initiate a new cohort of seedlings. Mature Douglas-fir can be killed by ground fires, but thick bark offers enough protection of the majority of adult trees. Young Douglas-fir are susceptible to fire, and can also act as ladder fuels to carry fire to crowns of trees. When stem density is high, an intense crown fire can develop. Crown fires, or slow spreading ground fires will commonly kill Douglas-fir trees over extensive areas. A prescribed burn of light to moderate intensity would remove ladder fuels, build-up of debris and could stimulate reproduction, as fir seeds ripen in burned cones and require relatively open conditions to sprout (Franklin and Dyrness, 1973), with resulting minor benefits to Douglas-fir forests.

Coast redwood (*Sequoia sempervirens*) is well adapted to fire. In other forests in Northern California (Annadel and Humboldt Redwood state parks), the fire regime prior to fire exclusion varied from every 2 to 6 years at one site to every 5 to 25 years at another. Recent prescribed burns resulted in stump sprouting where adults had been top killed. As redwoods achieved greater dbh, the probability of top-kill decreased. Flame length and fuel consumption were found to be the most important parameters in determining top-kill and basal sprouting. These parameters can easily be controlled by use of different firing patterns and fuel moisture to achieve the desired effects from a prescribed fire.

Seashore resource and fire managers are still working to determine the most effective methods for conducting prescribed burns in Douglas-fir and coast redwood forests in the project area. It would be beneficial, from both ecological and fire prevention perspectives, to reduce the density of some Douglas-fir stands, and to reduce the accumulations of ladder fuels. To do so safely, however, presents challenges. The NPS is considering the option of thinning smaller trees in selected stands of Douglas-fir prior to conducting prescribed burns. These trees would be no larger than 10 inches in diameter, and the thinning would be pre-approved by the Seashore's vegetation management staff prior to cutting. Removal of small-diameter trees removes the ladder fuels that carry fire into the crowns of larger trees, making prescribed burns safer to carry out.

Mitigation Measures

If pre-burn thinning of trees were required in forested stands, the trees to be thinned would be no larger than 10" in diameter.

Prior to conducting prescribed burning in Douglas-fir or coast redwood forests, Seashore fire and vegetation managers, and wildlife and plant ecologists would collaborate to fully develop rationale, objectives, prescriptions, and plans for conducting burns in the redwood forests within the project area.

Hardwood Forest

The responses of hardwood forests and their associated species to fire and fire suppression are variable, depending largely on characteristics of the dominant species. As most of the hardwood stands in the project area are strongly dominated by California bay and coast live oak, the effects of fire management activities on these species were primary considerations in this analysis.

California bay increases fuel loading by the continual shedding of its bark. Prescribed fire in hardwood forests has the potential to reduce this fuel load, and to stimulate reproduction, as studies indicate that germination of buried seed may slightly increase following light to moderate fire due to the cracking of the thin seed coat. Based on its prolific seedling ability and its ability to stump sprout, it is unlikely that California bay in the project area would suffer any long-term adverse effects associated with prescribed fire, and may experience negligible or minor benefits.

As noted above in cumulative impacts (for Alternative A), coast live oak displays several characteristics that make it highly resistant to damage from fires. These features ensure that few large trees are killed by low to moderate-severity prescribed fire. Use of fire is recommended for managing coast live oak woodlands, and to maintain natural borders between Douglas-fir forests and coastal sage scrub or mesic chaparral communities. For example, Douglas-fir encroaches into hardwood forest in the park where fire has been suppressed. In scrub communities, the exclusion of fire has allowed coast live oak to increase in density, with resulting reductions in the diversity and abundance of understory species. Prescribed fire can be useful in both eliminating Douglas-fir in hardwood habitat and eliminating coast live oak in scrub habitat.

Alternative B does not include any prescribed burning in hardwood forests for the purposes of re-establishing more natural boundaries of this vegetation type, but instead would be used to treat fuel build-up as it is in other vegetation communities. Hardwood forest occurs in all FMUs slated for treatment with prescribed burning. The focus of prescribed burning would be to reduce fuels in all vegetation types, but primarily in scrub and grassland. Therefore, prescribed burning deliberately targeting fuel build-up in hardwood forests is unlikely. Instead, this vegetation type would experience negligible to minor benefits from incidental reductions in fuels and possibly from the stimulation of dormant seeds.

Overall, treatments are expected to result in beneficial, minor to moderate (depending on the number of acres treated) long-term impacts as a result of improved forest health.

<u>Mitigation Measures</u>

Site-specific objectives would be developed for prescribed burns in hardwood forest habitat. The intent of such burns may be to reduce density or abundance of this vegetation type to encourage coastal scrub development, or may be to enhance the ecological health of the hardwood plant communities. Unique, site-specific burn prescriptions and timing would be required to meet these differing objectives.

Monterey Pine/Monterey Cypress
Monterey pine would be treated by prescribed burning in Estero and Limantour Road FMUs as it is in Alternative A.

Riparian Woodland
No prescribed burning would take place in riparian woodland in any alternative.

Coastal Scrub
In addition to continuing and expanding the use of fire to control non-native broom and other species in coastal scrub, prescribed burns would take place in several FMUs to either reduce fuels or achieve resource objectives. There also may be incidental benefits to coastal scrub and to grasslands where scrub is encroaching through prescribed fires primarily intended to reduce fuels.

Coastal scrub is largely fire-dependent, with prominent shrubs establishing by seed and by sprouting. It is a flammable vegetation type that may burn again 1 to 2 years after fire if dry conditions exist. With fire in less than 5-year intervals, or with overgrazing, coastal scrub generally reverts to annual non-native grassland. Fire exclusion in coastal sage scrub and mesic chaparral communities allows coast live oak, California bay, and other shade tolerant species to increase in density and reduce understory diversity and abundance.

Fire exclusion in coastal prairie allows coyote brush establishment, with best establishment in wet years. Complete conversion of purple needlegrass tussock grassland to coyote brush/ripgut brome stands has been observed with 24 years of fire exclusion. Coyote brush forms a closed canopy in about 2 to 3 years after invasion.

As noted in cumulative impacts, the dominant species in coastal scrub in the project area is coyote brush. This species sprouts from its root crown and roots after above ground vegetation is killed by fire. Sprouting ability lessens when it is reburned.

In this alternative, coastal scrub in the Palomarin FMU would be burned to remove encroaching Douglas-fir and to maintain habitat for birds around the Point Reyes Bird Observatory. Burns would be less than 50 acres and effects would be monitored to determine if benefits of prescribed burning warrant a wider scale application. Douglas-fir trees less than 10” dbh would be cut before the area is burned to reduce risk of fire spread and to increase Douglas-fir mortality. Small prescribed burns in the Limantour Road corridor to reduce fuel accumulations in coastal scrub could have secondary resource benefits. Prescribed burns in the southernmost portion of Bolinas Ridge FMU in coastal chaparral and mixed scrub habitat to reduce fuels also would help stimulate reproduction in the rare, fire adapted species Marin manzanita and Mason’s ceanothus.

In addition to minor to moderate benefits to this community from removing Scotch and French broom, additional minor benefits to coastal scrub health and reproductive rates are likely due to pilot burns at Palomarin and the use of prescribed fire to reduce fuels.

<u>Mitigation Measures</u>
Small pilot burns (> 50 acres) would be conducted in coastal scrub. These burns would be carefully monitored to ensure burn objectives (= recruitment and long-term maintenance of native species without introduction of invasive non-native plant species) are being met. If pilot projects determine objectives can be met using prescribed fire, individual burn size would increase to a maximum of 200 acres.

Grassland
Prescribed burns and mechanical treatments would occur in grasslands in numerous FMUs under Alternative B. In Limantour Road FMU, additional burning specifically to reduce fuels in grasslands would take place along the road corridor and around developed areas in the park. The same is true of Highway One FMU. Grasslands and shrublands along Bolinas Ridge and in grasslands along the Bolinas Ridge Fire Road would be burned to reduce fuels. Treatments would occur primarily along road edges, and around structures to reduce fire hazard.

As noted in Alternative A, prescribed burning in grasslands must be precise and monitored carefully to achieve desired results as non-native grasses are sometimes favored by fire. For example, while a combination of prescribed fire and mowing has been successful in removing Scotch broom from some grassland communities, prescribed burning of the highly invasive purple velvet grass may be increasing its abundance. Monitoring and adaptive management (e.g., changing the prescription if non-natives are not destroyed) are mitigation measures that would be used to minimize potential adverse effects of prescribed burning in grasslands.

Mitigation Measures
All grassland burns would be carefully monitored to ensure burn objectives (= recruitment and long-term maintenance of native species without introduction of invasive non-native plant species) are being met.

To enhance grassland plant species composition, and reduce the chance of invasion or spread of non-native species, native seeding trials would be conducted following fire management treatments in some areas.

Impacts of these activities on vegetation are expected to be adverse, negligible to minor, and short- to long-term if non-native species expand in density or aerial extent as a result of treatments. Beneficial, minor to moderate, long-term impacts to vegetation would occur in some areas of grassland habitat as stands of Scotch or French broom are reduced.

Pasture
Under this alternative, small areas supporting the non-native species Scotch broom, French broom, or Monterey pine within pasture may be burned or mowed to reduce the density and aerial extent of these invasive species. Impacts associated with these efforts would be beneficial, minor to moderate, and long-term as a result of removal of invasive non-native plants. For these beneficial impacts to persist, however, follow-up activities must be conducted to remove new recruits that come into the sites in years following prescribed burning or mechanical treatments. Adverse, minor, short- to long-term impacts also could occur as a result of application of fire management activities if other non-native invasive plant species invade or spread on treated sites.

Unplanned Ignitions, Wildland Fire, and Suppression

The impacts described above from average wildland fire and suppression for Alternative A would be true of this alternative as well.

Mechanical Treatment

Alternative B would treat twice as many acres as Alternative A with mechanical means, and would add mechanical treatment in the following FMUs: Tomales Point, Inverness Ridge, Wilderness North and South and Palomarin. As in Alternative A, the focus of mechanical treatment would be to control non-native species and reduce fuels. In addition, mechanical treatment would be used where reduction of fuel could help firefighters slow or stop the spread of fires in the event of an unplanned ignition, such as along Inverness Ridge.

Bishop pine
In addition to the mechanical treatment identified in Alternative A, concentrations of fuels would be reduced by limbing bishop pine along primary roads and along secondary fire roads. A 3 mile long fuel break in Inverness FMU also may result in some removal of Bishop pine. The fuel break would be 50-60 feet wide. Within it, dead and downed woody debris would be reduced by 60%, trees would be limbed up to 10 feet in height, trees up to 4 inches in diameter would be thinned and brush would be cut in a mosaic pattern to break up fuel continuity. The creation of the fuel break could mean a reduction in the risk of a catastrophic fire spreading. It also may provide minor benefits to Bishop pine by opening the canopy to sunlight and promoting the opening of this species' cones

Douglas-fir/Coast redwood
Under this alternative, thinning of Douglas-fir/coast redwood would take place along the sides of roads, including Limantour Road and Highway One. Trees less than four inches in diameter would be removed from a corridor 10-15 feet wide on each side of the road, and larger trees would be limbed up to a height of 10 feet. This would help to create a corridor of defensible space along these roads. Douglas-fir/redwood forests also would be subject to mechanical thinning prior to prescribed burning in Wilderness North and Wilderness South FMUs to increase the ability to control prescribed and wildland fire. Mechanical treatments are expected to cause beneficial, minor to major (depending on the number of acres treated) long-term impacts as a result of improved forest health and reduced risk of large-scale unplanned catastrophic wildland fire.

Monterey pine/Monterey cypress
Both Monterey pine and Monterey cypress would be treated by mechanical means in Alternative B. Monterey pine would be cut and the stumps treated with herbicide in both Estero and Limantour FMUs. Monterey cypress would be cut and stump treated in Tomales Point and Estero FMUs. Because the distribution of both species is limited, this approach of treating individual trees could substantially reduce their extent, and impacts to native vegetation could be minor to moderate, long-term and beneficial. For these beneficial impacts to persist, however, follow-up activities must be conducted to remove new recruits that come into the site in years following mechanical treatments.

Hardwood Forest
Thinning along roadsides would continue in Alternative B as it does in Alternative A, and some hardwood species would be removed or limbed. Alternative B would also target non-native eucalyptus for mechanical removal in several FMUs.

Eucalyptus forests in the park are dominated by the non-native blue gum eucalyptus, which has been planted and has encroached on native plant communities. Eucalyptus is usually highly dominant in the canopy. Monterey pine, Monterey cypress, or individual Douglas-fir, California bay, or coast live oak also may be present. Understory vegetation usually is sparse, often including remnants of the native community, because eucalyptus creates a deep litter containing chemicals that discourage growth of other species. Poison oak and non-native or native berries (e.g., *Rubus* spp.) are common shrubs. Other non-native shrubs and herbs often are present with low cover. The floor of eucalyptus forests is characterized by a thick layer of eucalyptus litter comprised of bark, seedpods, leaves, and branches.

The combination of thick litter, hanging strips of bark, and volatile chemicals in the wood and litter of eucalyptus mean a fire in these forests is highly likely to burn hot and reach the crown. Fire does not kill adult trees, but does open seedpods and prepare the seedbed, enhancing regeneration. As noted above, it is the policy of the NPS to promote native species and remove non-native plants and animals as parks are able to do so. In Alternative B, eucalyptus stands in Tomales Point, Estero, and Highway One would be targeted for thinning or removal, with larger trees stumps treated with herbicides to prevent resprouting. Mechanical removal of individual eucalyptus trees could have minor to moderate benefits for native vegetation.

Table 51. Eucalyptus Acreage occurring within Fire Management Units.

Fire Management Unit	Alternative A	Alternative B	Alternative C
Tomales Point		17	17
Headlands			
Estero	11	11	11
Inverness Ridge			
Limantour Road	14	14	14
Wilderness North		3	3
Wilderness South			
Highway One	94	94	94
Bolinas Ridge			
Palomarin		26	26
Totals	119	165	165

Riparian Woodland
No mechanical treatment would occur in riparian woodland in any alternative.

Coastal Scrub
Impacts from mechanical treatment of coastal scrub would be the same as described for Alternative A. Mowing to target Scotch and French broom would continue and expand, with possible moderate or even major beneficial impacts to native coastal scrub species.

Grassland
Scotch and French broom also occur in grasslands, where mechanical treatment by mowing would be used to help control the spread of these species. Possible moderate benefits to grasslands would occur from their removal.

Pasture
As noted above, treatment would generally not occur in pasture, although some mowing of Scotch and French broom is possible with minor or moderate benefits.

Coastal Dune

Coastal dunes occur in the Tomales Point FMU. These dunes are largely dominated by the non-natives plants European beachgrass and iceplant. The Seashore is undergoing a large-scale dune restoration program that involves manual and mechanical removal of European beachgrass. Mechanical removal of this non-native would have minor beneficial effects on native dune species.

Fire Information/Education

Same as Alternative A.

Fire Cache/Park Headquarters Relocation and Construction

Same as Alternative A.

Fire Effects and Fuel Management Research

Alternative B includes the use of pilot burns in Douglas-fir and coastal scrub communities to determine effects in promoting native species and reducing or removing fuels and non-native species. In Bolinas Ridge FMU, the effects of prescribed burning on native plant species richness would be explored, and in Palomarin FMU, the effects on birds would be assessed. If effects are beneficial, and such treatments are later applied to large areas of the park, widespread minor to major benefits to vegetation could result.

Cumulative Impacts

The risk of unplanned wildland fire would be slightly less under Alternative B (as compared to Alternative A) as mechanical treatments and prescribed burning would be designed and implemented to reduce such risk. However, the impacts described above for Alternative A would be the same for this alternative, with short- to long-term, major adverse impacts to vegetation possible.

Conclusion

Similar impacts to those for Alternative A from prescribed burning would occur in Monterey pine forests and pasture. Minor to moderate benefits from prescribed burning in hardwood forests are possible. Pilot burns in Douglas-fir forests could provide minor benefits by removing ladder fuels and debris and stimulating reproduction. Removal of non-native Monterey pine trees in Estero and Limantour Road FMU would have a localized minor to moderate long-term beneficial impact to native vegetation, but minor adverse impacts could also occur from burning if non-native species increase their aerial extent. Continued treatment of non-native Scotch broom may provide minor to moderate benefits to coastal scrub and grassland habitat if applied throughout the area where it occurs. Additional minor benefits to coastal scrub from prescribed burning to increase native species richness would occur in Palomarin and Bolinas Ridge FMUs. Prescribed burns and mechanical treatments in grasslands could have beneficial or adverse impacts, as results are highly variable. Monitoring and adaptive management would keep these impacts from becoming more than minor if they are adverse.

Average unplanned wildfires and their suppression could have minor, short-term adverse or beneficial impacts on vegetation. Benefits may result from stimulation of fire dependent native species, or from the destruction of non-natives. Adverse impacts come from the loss of native species, as well as from crushing, removal or other physical impacts of suppression.

Mechanical fuel reduction in Bishop pine, Douglas-fir and hardwood forests would result in negligible to minor, short-term adverse impacts. Addition minor long-term beneficial or adverse impacts from the removal of several acres of bishop pine to create a fuel break in Inverness FMU would occur. Localized minor to moderate long-term benefits to native vegetation would result from the mechanical removal of Monterey pine in Estero and Limantour Road FMUs, of Monterey Cypress from Tomales Point and Estero FMUs, and of eucalyptus from Tomales Point, Estero, and Highway One FMUs. Moderate to major benefits to coastal scrub, grasslands, and pasture from the continued removal of Scotch broom and French broom would result from the combination of mechanical mowing and prescribed burning techniques. The continuation of research and wide application of its results would increase these benefits over a wider geographic area.

The risk of a large wildfire, and its likely extent should it occur, would be less under Alternative B, as compared to Alternative A, especially after several years of treatment have taken place. In some native vegetation communities, such as Bishop pine or hardwood forest, large-scale fire could be beneficial by eliminating non-native species or otherwise creating conditions favoring the spread of native plants. In others, such as Douglas-fir/coast redwood forests, hot crown fires can destroy the native seed source over a large area, making re-establishment difficult. Riparian areas also may experience major adverse impacts from very intense fires due to destruction of seed source or root crown. The effect of a wildland fire in coastal scrub or grassland is more complex and less well understood, as some native and non-native species are benefited and some are adversely affected. Overall, the cumulative effects of a large-scale fire and all other activities such as development, historic logging, disease and the introduction of non-native plant species have and would continue to have major, long-term adverse impacts on native vegetation communities in the park.

No impairment to vegetation would result from this alternative.

Alternative C

Alternative C would include all activities as described above for Alternative B, and would include prescribed burning on an additional 1000 acres per year (to total 2000 acres of prescribed burning) and would include mechanical treatment on up to 1500 acres per year. In addition to more treatment to reduce fuels and increase the ability to fight wildfires, under Alternative C, the Seashore would use fire and mechanical means to enhance the condition of natural and cultural resources. Some treatment of natural resources would involve the widespread attempt to eliminate non-native species, but treatment to improve species richness and wildlife habitat also would occur. Alternative C is the only alternative to use prescribed fire in Tomales Point and Headlands FMUs.

Analysis

Prescribed Fire

Bishop Pine Forest

The same treatment and resulting impacts of incidental use of prescribed fire in Bishop Pine as described in Alternative B are expected. However, additional research would be conducted to determine the effects of burning on Bishop pine populations and associated plant species, as well as on dusky-footed woodrats (Northern Spotted Owl prey species) and on Point Reyes mountain beavers.

Douglas-fir/Coast Redwood Forest

Additional pilot burns in Douglas-fir/coast redwood forests may be conducted in this alternative, with resulting benefits from reductions in ladder fuels and increased reproductive response. Eventually, fire would be reintroduced to Douglas-fir forests in some FMUs (Wilderness North and Wilderness South), returning a natural environmental process that has been lost or altered for at least a century. The benefits to these stands of Douglas-fir/coast redwood could be major and long-term, depending on the aerial extent of treatment.

Hardwood Forest

Prescribed burning could occur in hardwood forests in nine of the ten FMUs subject to treatments under Alternative C (the remaining FMU - Headlands - does not support these forest types). Because eucalyptus is a non-native hardwood species highly adapted to fire, treatments would include consideration of eucalyptus ecology and whether or not treatment would cause it to spread. In both this alternative and in Alternative B, eucalyptus would be mechanically thinned or removed for this reason. Because other California hardwood species are also fire-adapted, removing exotics mechanically and then burning would result in beneficial, moderate to major (depending on the number of acres treated) effects. Beneficial impacts under Alternative C would be greater than under Alternative B because twice the acreage could be treated.

Monterey Pine/Monterey Cypress

Both Monterey pine and Monterey cypress would be subject to prescribed burning in Alternative C. Monterey cypress (see Alternative A for information on Monterey pine) is fire-adapted in that its cones require heat to open, but it is capable of establishing seedlings with or without crown fire. In California, late summer or early fall fires are followed by winter rains. These provide exposed mineral soil for seeds and moist conditions ideal for germination. Although some larger Monterey cypress adults may survive fire, the majority of wildfires would kill most individuals. The frequency of fire is important in managing non-native Monterey cypress. If groves are burned with prescribed fire often, reproduction could be eliminated, as remaining trees would be unable to mature and produce cones. Fire followed by intensive grazing also could eliminate a cypress grove. Prescribed burning of Monterey cypress would occur in Estero FMU, and could have a minor to moderate benefit on native vegetation in areas where this species now dominates.

Coastal Scrub
In addition to the impacts described above for Alternative B, this alternative includes small prescribed burns in the Tomales Point FMU to determine the response of plant communities, including plant species of special concern.

Grassland
In addition to the use of fire as described in Alternatives A and B, small prescribed burns in grasslands in Tomales Point and Headlands FMUs would occur in Alternative C. In Tomales Point, fire would be applied based on previous research results in other California grasslands to encourage a larger proportion of native species to become established. In Headlands FMU, pilot burns on velvet grass would be conducted to determine if burning will reduce the aerial extent and density of this species. As in other alternatives, the prescriptions would be fine-tuned in grasslands to ensure native species are favored. Minor to moderate benefits from these pilot burns are possible if they are successful and applied widely.

Mitigation Measures
In the Tomales Point FMU, small pilot burns (less than 100 acres) would be conducted in grassland to determine plant community response. These burns would be carefully monitored to ensure burn objectives (= recruitment and long-term maintenance of native species without introduction of invasive non-native plant species) are being met. If pilot projects determine objectives can be met using prescribed fire, individual burn size would increase to a maximum of 150 acres.

Pasture
Impacts would be similar to those described above for Alternative B.

Coastal Dune
Coastal dunes cover a small number of acres in the FMUs slated for treatment, primarily in the Headlands FMU, and to a lesser degree in the Tomales Point FMU. These dunes are largely dominated by the non-native plants European beachgrass and iceplant. The Seashore is undergoing a large-scale dune restoration program that involves manual and mechanical removal of European beachgrass, and piles of beachgrass that have been pulled may be burned. Because they are non-native, removing these species through burning would be beneficial, minor, and long-term.

Unplanned Ignitions, Wildfire, and Suppression

The impacts described above from average wildland fire and suppression for Alternative A would be true of this alternative as well.

Mechanical Treatment

Alternative C would treat three times as many acres as Alternative A with mechanical means, and would treat more acres within the same FMUs as Alternative B. The focus of mechanical treatment would be the same as in Alternative B, and the reasons for mechanical treatment would remain virtually the same as in Alternative B. Only the extent of treatment would change. Because of this, vegetation types are not analyzed individually in Alternative C.

Fire Information/Education

Same as Alternative A.

Fire Cache/Park Headquarters Relocation, and Construction

Same as Alternative A.

Fire Effects and Fuel Management Research

Under Alternative C, the fire management program would be guided to a greater degree than in other alternatives by the results of research on the ecological effects of fire and mechanical treatments. Ongoing research on Scotch broom, velvet grass, and rare chaparral plants would continue, and research on the effects of prescribed burning would expand into additional habitat types, including coastal grassland, Douglas-fir forest, riparian woodland, and Bishop pine forest. If the results of these studies are ecologically favorable (e.g., lead to increased native species richness, create areas supporting a variety of age classes within habitat types, and/or result in increases in rare species abundance or distribution) additional prescribed burning would occur in subsequent years in those habitat types.

Under this alternative, the research program also would be expanded to include studies on the effects of mechanical fuels treatments on ecological parameters. Vegetation would be selectively removed from within Douglas-fir forests and in shrub-dominated habitats such as coastal scrub and chaparral to determine the effects of such removal on physical and biological elements (e.g., soils, selected plant species).

Cumulative Impacts

The risk of unplanned wildland fire would be moderately reduced under Alternative C (as compared to Alternative A) as mechanical treatments and prescribed burning would be designed and implemented to reduce such risk. However, the types of impacts described for Alternative A would be the same for this alternative should a wildfire occur, with short- to long-term, major adverse impacts to vegetation possible.

Conclusion

In the FMUs treated with prescribed fire, minor, short-term adverse impacts associated with loss of vegetation, and the possibility of introduction or spread of non-native plants could be greater than under other alternatives. However, the burns also would result in minor to moderate beneficial impacts as burns would stimulate growth of many native plant species, and would kill non-native vegetation. Although they would remain moderate, the potential for beneficial effects from Alternative C are greater than Alternative A or Alternative B because 2000 acres would be treated.

Mechanical fuel reduction would have minor short-term adverse impacts on native vegetation through crushing or other physical impacts, but clearing of dense vegetation also would have possibly long-term, minor to moderate benefits on most plant communities as well. The effects would be greater under this alternative than under Alternative A or Alternative B because more acres would be treated.

All of the beneficial impacts for prescribed burning and mechanical treatment described for specific vegetation types in Alternative B also would occur in this alternative. These include minor benefits to Douglas-fir forests by removing ladder fuels and debris and stimulating reproduction, minor to moderate benefits from removal of Monterey pine and Monterey cypress through prescribed burning and mechanical means, minor to major benefits to coastal scrub and grassland habitat from the removal of Scotch and French broom, and minor benefits to coastal scrub from prescribed burning to increase native species richness. Additional possibly major benefits to Douglas-fir forests from the return of natural fire intervals following treatment with prescribed burning are likely, and minor benefits to coastal dune vegetation from the burning of non-native beachgrass is possible.

Average unplanned wildfires and their suppression could have minor, short-term adverse or beneficial impacts on vegetation. Benefits may result from stimulation of fire dependent native species, or from the destruction of non-natives. Adverse impacts come from the loss of native species, as well as from crushing, removal or other physical impacts of suppression.

Adverse and beneficial impacts from mechanical treatment would be very similar to those in Alternative B. These include negligible to minor short-term impacts to forest vegetation from killing individuals, balanced with minor to moderate beneficial impacts associated with fuel reduction and thinning; localized minor to moderate long-term benefits to native vegetation from the mechanical removal of Monterey pine, Monterey cypress and eucalyptus; and moderate to major benefits to coastal scrub, grasslands, and pasture from the continued removal of Scotch broom and French broom. The continuation of research and wide application of its results would increase these benefits over a wider geographic area.

The risk of a large wildfire, and its likely extent should it occur, would be reduced under Alternative C (compared to Alternative A), especially after several years of treatment have taken place. In some native vegetation communities, such as Bishop pine or hardwood forest, large-scale fire could be beneficial by eliminating non-native species or otherwise creating conditions favoring the spread of native plants. In others, such as Douglas-fir/coast redwood forests, fires could either have substantial beneficial effects or hot crown fires could destroy the seed source over a large area, making re-establishment difficult. Riparian areas may also experience major adverse impacts from hot fires from the destruction of seed source or root crown. The effect of a wildland fire in coastal scrub or grassland is more complex and less well understood, as some native and non-native species are benefited and some are adversely affected. Overall, the cumulative effects of a large-scale fire and all other activities such as development, historic logging, disease, and the introduction of exotics have and would continue to have major, long-term adverse impacts on native vegetation communities in the park.

No long-term impairment to vegetation would result from this alternative.

IMPACTS TO WETLANDS

Alternative A

Analysis

Impacts to wetlands associated with fire management activities are similar in many respects to impacts described in the preceding sections on soils and vegetation. Impacts on wetland sites, however, can differ from impacts on upland sites because wetlands usually have a higher level of soil moisture and denser vegetation cover than non-wetlands, which can result in variable impacts. These conditions can result in wetlands being more vulnerable to impact from certain activities. For example, fire suppression activities such as cutting handline or dozerline in wetlands can be very destructive if conducted when soils are wet. Although any site, either upland or wetland, can have high soil moisture at certain times of the year, it is more likely that wetland sites will be wetter year round, and therefore these sites require additional consideration, and different mitigation measures, to ensure their protection. Additionally, the higher level of legal protection that is afforded wetlands requires that additional care be taken to protect these sites.

There is little literature available that describes the specific effects of fire on wetland ecosystems, particularly for wetlands in the western United States. This lack of information is discussed by researchers with the United States Geological Survey Northern Prairie Wildlife Research Center, who compiled the web-based “Fire in North American Wetland Ecosystems and Fire-Wildlife Relations: An Annotated Bibliography.” In the Introduction to the bibliography, they state:

“Surprisingly few papers have addressed aspects of fire-wetlands relations; fewer yet have had this subject as a major focus of investigation. In general, fire has been treated as one of a number of management tools appropriate for wetlands, with its major use that of eradication of undesirable vegetation. Unlike the literature on fire in terrestrial upland communities, however, specific fire prescriptions, knowledge of fire behavior under different fuel loadings and environmental conditions, and the detailed consequences of differing fire frequencies, fire intensities, and fire severities in wetlands are largely unknown.”

Despite this lack of specific information, as with all vegetation types, impacts of fire on wetlands are a function of 1) the severity of the fire itself, and 2) characteristics of the particular plants on the site.

Two pieces of evidence suggest burning in wetlands has some benefits. First, the landscape of Point Reyes is one that has periodically burned over time (see Fire History in Affected Environment), and fires have included wetlands. Second, research of effects in wetlands shows that, if burned areas retain seed of native species in the soil, or if burns create a mosaic pattern with some surviving native vegetation or resprouting native vegetation, within a few years it can be difficult to determine that a fire recently occurred (Miller, 2000). It is also known that some species of wetland plants are stimulated to reproduce through seed germination, and by sprouting from stems, roots or rhizomes following fires.

Prescribed Fire

Burn plans that include prescribed burning in wetland areas are subject to the conformance with additional regulations when applying to BAAQMD. In addition to the SMP and other submittals, Regulation 5, Section 410, Marsh Management Burn Requirements, asks for an evaluation of non-burning alternatives that could achieve land management objectives in keeping with resource management plans that apply to the project area. Regulation 5, Section 401.13 includes more detailed guidance for planning prescribed burns that involve wetland acreage.

This alternative would not specifically burn wetland areas with prescribed fire, although it would not include any measures specific to keep nearby burns from entering wetlands. Marsh and other wetlands occur in three of the four FMUs that could be receive prescribed burning (Estero, Limantour Road and Highway One). Prescribed fire would be used in these three FMUs to treat Scotch broom, French broom, and Monterey pine. These would be low to moderate intensity burns, which generally burn near or around moist wetland soils, rather than in the wetlands themselves. However, burning in grasslands to eradicate broom for example could result in some encroachment of non-native grasses or other plant species, which may also invade the adjacent wetland. If burns are prescribed in the summer or fall, when seasonal wetlands are dry, some impact from the loss of vegetation is possible. In dry years, prescribed fire may burn into perennial wetlands as well. These are possible minor adverse impacts, but the burns could also have minor to moderate beneficial impacts on wetland vegetation by stimulating growth and reproduction in native wetland species, and possibly by killing non-native species.

Unplanned Ignition, Wildfire, and Suppression

The potential impacts of wildland fire suppression on wetlands are similar to potential impacts of wildland fire suppression on other vegetation classes as described in the previous section (Impacts on Vegetation). Due to increased moisture levels often present in wetlands, however, such impacts can be more severe.

Point Reyes has had an average of three unplanned fires annually, with each fire burning less than ten acres. As these are unplanned events, information on direct effects can only be obtained after the fire, and would involve documenting effects on resources for which little pre-burn data may exist. The impacts on wetlands associated with these small unplanned wildfires and their suppression are expected to be both adverse and beneficial. Adverse impacts are expected to be minor and short-term. It is possible that small invasions of non-native plants would result from these fires, which could result in a longer-term impact, but the impact would be localized. Small unplanned wildland fires in the project area may have some beneficial impact on wetlands in localized areas if non-native plants are killed, and native plants establish on the site following the fire.

Mechanical Treatment

Up to 500 acres of mechanical treatment in Estero, Limantour Road, and Highway One FMUs would be conducted under this alternative. All of these FMUs have wetland acreage, although no treatment of wetlands specifically would take place.

Mechanical treatments would avoid wetland areas to the greatest extent possible. If such treatments in wetlands were deemed necessary to ensure fire safety around structures or along roads, these treatments would have adverse impacts on vegetation. Some native vegetation would be killed or damaged, and treatments could result in localized introduction or spread of non-native species. These impacts would be considered adverse, negligible to minor, and short-term. In some cases, clearing of dense vegetation could result in increased growth or establishment of native wetland species by creating gaps or openings in canopy cover, and could result in a decrease in non-native plants on treated sites. These impacts would be considered beneficial, minor, and short- to long-term.

Fire Information/Education

This would have no beneficial or adverse effects on wetlands.

Fire Cache/Park Headquarters Relocation, and Construction

The construction of a fire cache at Bear Valley would not have a beneficial or negative impact on wetlands. The building would be located at least 100 feet from the Bear Valley Creek riparian zone and temporary construction plastic fencing would be used to eliminate any impacts to resources in this zone. In addition, the site is a former trailer pad and nearly unvegetated and no wetlands are located on the construction site.

Fire Effects and Fuel Management Research

This would have no adverse effects on wetlands. Any post-treatment monitoring would have an indirect benefit by providing greater knowledge of the effects of prescribed fire and mechanical treatments on wetlands in the project area.

<u>Mitigation Measures</u>

Burns would be allowed to back into and burn around wetlands and meadows or through them if the vegetation is dry enough to carry fire. Wetlands would be avoided to the greatest extent possible during fire confinement and containment.

Fire suppression activities would not occur in wetlands unless there are no alternatives available to control the spread of a wildland fire.

Fires near wetlands would be ignited when wetlands are too moist to sustain fire spread, thereby minimizing impacts to wetlands.

To the greatest extent possible, mechanical treatments would not occur in wetlands.

Wetlands may be used as a natural boundary for prescribed fires. When a wetland area is being used as a boundary, line construction would occur in adjacent uplands, not in wetlands.

Prescribed fires would not occur more frequently than the time required for native plant species to set seed.

Foams or other fire retardants would not be used in or near wetlands.

Firebreaks or firelines would be constructed in previously disturbed areas whenever possible.

Chipped material would not be spread in wetlands.

Cumulative Impacts

Cumulative impacts to wetlands include pollution, runoff, encroachment of non-native species, and draining or deepening for development on land or of marinas. In the park, projects listed in Appendix C could have combined impacts on wetlands, but the chance of this is remote, since wetlands are protected by special legislation and NPS policies prohibit development within a wetland when other options are available. Therefore impacts to wetlands in the study area from all but a large wildfire, should it occur, are negligible or minor.

Treatment of 1000 acres per year by prescribed fire and mechanical means to reduce fuel loads would have little effect in reducing the risk of a large wildfire, even over several years. High-severity fires in Point Ryes such as the Vision Fire are characterized by extensive burned areas that may be continuous from ridgeline to slope bottom and include riparian areas and wetlands. The direct effects of high intensity wildland fires on wetlands can be substantial, including the destruction of both wetland vegetation and the seeds, roots, and rhizomes that would have allowed native species to repopulate. Over the long-term, permanent changes in plant species composition or percent cover, and the introduction or spread of non-native invasive plant species can result. Revegetation of wetlands could take many years. During extreme weather events, debris torrents would potentially scour streams, further delaying restoration of the riparian community and associated wetlands. Because non-native species also exist in the park, colonization of wetlands by these species or even habitat type conversions is possible with intense wildfires.

Large, high-intensity fires also can cause ecosystem fragmentation, which can create barriers to wildlife movements and affect seed sources, nutrients, and plant distribution patterns in wetland communities. Loss of vegetation in a wetland can reduce the ability of the wetland to filter incoming surface water flows, resulting in changes in water quality; can lead to increased soil erosion in or near the wetland; and can cause an increase in water temperatures if the wetland supports open water.

Activities to suppress large wildland fires could have substantial, although localized, impacts if wetlands are treated with retardant, or if a fireline is constructed. Such activities would not occur in wetlands to the greatest extent possible. The actual extent and magnitude of impacts are impossible to predict, however, as these fires are unplanned. All of these impacts would be mitigated following a fire with assistance from the NPS Burned Area Emergency Rehabilitation (BAER) program.

Overall, impacts to wetlands from a large wildfire could be major, long-term, and adverse.

Conclusion

Minor adverse impacts are possible from prescribed fires burning near and into wetlands in dry years. Minor to moderate benefits on wetland vegetation are possible if fire intensity is low to moderate due to reduction of non-native plant species or stimulation of germination and resprouting in native species.

Minor adverse impacts from unplanned wildfires and their suppression could occur. Minor beneficial effects also could occur due to reduction of non-native plant species or stimulation of germination and resprouting in native species.

Mechanical treatments would avoid wetland areas to the greatest extent possible. If such treatments in wetlands were deemed necessary to ensure fire safety around structures or along roads, these treatments would have negligible to minor adverse impacts on vegetation. Clearing vegetation also could have minor benefits to wetland species if native species establishment is enhanced.

Cumulative impacts from development in the park may have a minor adverse impact on wetlands. However, a large-scale wildfire could have major, long-term, adverse impacts on wetlands from destruction of vegetation and reproductive ability, and invasion by non-native species.

No long-term impairment to wetlands would result from this alternative.

Alternative B

Analysis

Prescribed Fire

Under Alternative B, up to 1000 acres per year would be treated using prescribed fire in the Estero, Inverness Ridge, Wilderness North, Wilderness South, Limantour Road, Highway One, Palomarin, and Bolinas Ridge FMUs. Wetlands are present in all of these FMUs except Bolinas Ridge, although no treatment directed at wetlands would occur.

Wetland areas would generally be avoided and buffered from burns. However, if prescribed burns are allowed to burn into adjacent wetlands, minor impacts from killing wetland vegetation occur. These would be offset by minor to moderate benefits from killing non-native species and from stimulating reproduction of many native plant species. The effect of Alternative B would be greater than Alternative A because 1000 acres would be treated.

Unplanned Ignition, Wildfire, and Suppression

Same as Alternative A.

Mechanical Treatments

Mechanical fuel reduction techniques would have both adverse and beneficial impacts on wetland vegetation. Some native vegetation would be killed or damaged, and treatments could result in localized introduction or spread of non-native species. These impacts would be considered adverse, short-term, and minor. The impacts would be minor because wetland areas would be avoid and buffered from mechanical treatments. In some cases, however, clearing of dense vegetation could result in increased growth or establishment of native and rare species. These impacts would be considered beneficial, possibly long-term, and minor to moderate. The effects would be greater under this alternative than under Alternative A because twice as many acres would be treated.

Fire Information/Education

Same as Alternative A.

Fire Cache/Park Headquarters Relocation, and Construction

Same as Alternative A.

Fire Effects and Fuel Management Research

Same as Alternative A.

Cumulative Impacts

Same as Alternative A.

Conclusion

Although wetland vegetation would be avoided and buffered from nearby prescribed burning or mechanical treatment for the most part, some of each of these treatments may take place for resource management or safety reasons. If so, minor localized adverse impacts from either to vegetation could occur from crushing, removal, or burning. However, minor to moderate benefits from killing non-native vegetation or stimulating reproduction is also possible.

Minor adverse impacts from unplanned wildfires and their suppression could occur. Minor beneficial effects also could occur due to reduction of non-native plant species or stimulation of germination and resprouting in native species.

Cumulative impacts from development in the park may have a minor adverse impact on wetlands. However, a large-scale wildfire could have major, long-term adverse impacts to wetlands from destruction of vegetation and reproductive ability, and resulting invasion by non-native species. This is true despite the reduced risk of such a fire related to fuel reduction activities across the project area in this alternative.

No long-term impairment to wetlands would result from this alternative.

Alternative C

Analysis

Prescribed Fire

Under Alternative C, a total of 2000 acres per year would be treated using prescribed fire in all of the same FMUs as in Alternative B, and in Tomales Point and Headlands FMUs as well. Wetlands are present in all but the Bolinas Ridge FMU.

Impacts would be similar to those described above for Alternatives A and B. Although adverse impacts may be greater than other alternatives, they would remain short-term and minor because wetlands are largely kept unburned and are buffered from nearby prescribed burns. Benefits from killing non-native plants or stimulating regrowth of natives would be minor to moderate as they are in Alternative B.

Unplanned Ignition, Wildfire, and Suppression

Same as Alternative A.

Mechanical Treatments

Adverse and beneficial impacts from mechanical treatment in this alternative would be similar to those described above for other alternatives. Minor adverse effects from killing or damaging wetland vegetation are possible but unlikely, and minor to moderate benefits from clearing dense vegetation and encouraging establishment of wetland vegetation may occur. The effects would be greater under this alternative than under Alternatives A and B because more acres would be treated.

Fire Information/Education

Same as Alternative A.

Fire Cache/Park Headquarters Relocation, and Construction

Same as Alternative A.

Fire Effects and Fuel Management Research

Same as Alternative A.

Cumulative Impacts

Same as Alternative A.

Conclusion

Prescribed burns would have minor, short-term adverse impacts because fire would kill some wetland plant species, and could result in the introduction or spread of non-native vegetation. The effect of Alternative C would be greater than Alternatives A and B because 2000 acres would be treated.

Minor adverse impacts from unplanned wildfires and their suppression could occur. Minor beneficial effects also could occur due to reduction of non-native plant species or stimulation of germination and resprouting in native species.

Mechanical fuel reduction techniques would have both adverse and beneficial impacts on wetland vegetation. Some native vegetation would be killed or damaged, and treatments could result in localized introduction or spread of non-native species. These impacts would be considered adverse, short-term, and minor.

Cumulative impacts from development in the park may have had a minor impact on wetlands. However, a large-scale wildfire could contribute major, long-term adverse impacts to wetlands from the destruction of vegetation and reproductive ability, and resulting invasion by non-native species. This is true despite a moderate reduction in risk of such a fire related to fuel reduction activities across the study area in this alternative.

No long-term impairment to wetlands would result from this alternative.

IMPACTS TO WILDLIFE

Types of Impacts

The types of impacts on wildlife caused by prescribed fire and small-scale wildland fire are similar. Quantifying or accurately predicting such effects is difficult because fire is inherently unpredictable. For example, fire intensity (which strongly influences the degree of impacts) varies substantially in response to season, wind, air temperature, relative humidity, composition of fuels, topography, and other parameters. Because of the inability to predict the nature of wildland fires, this analysis of the effects of wildfire on wildlife is qualitative. The effects of prescribed burning on wildlife are somewhat more predictable and easier to mitigate through careful planning and implementation; nonetheless credible scientific data on such effects in the project area are scant.

Generally, the effects of fire on wildlife depend on the characteristics of the fire itself (e.g., intensity, duration, frequency, size, shape, season, and time); the characteristics of the vegetation or habitat burned; and on species characteristics (e.g., size, mobility, habitat preferences). Modification of habitat, food, water sources, and cover would determine if a given species persists, thrives or declines in response to fire. Changes in vegetation structure and composition in the understory and overstory, as well as resultant changes in microclimates within and adjacent to burn units, will also affect wildlife species (McMahon and deCalesta, 1990).

The types of impacts to wildlife can be direct or indirect. Direct impacts include incineration, asphyxiation, injury, or avoidance of an area, and are most often experienced by less mobile species of life stages. Wildlife may also experience indirect effects. For example, fish or aquatic invertebrates can be harmed by sedimentation in a creek due to post-fire soil erosion, or carnivores can suffer from reductions in the prey base as a result of either direct mortality of the prey, or a reduction in the food and cover resources used by the prey species.

Habitat loss itself is a possible adverse indirect impact from fire, and can be short- or long-term. Changes in vegetation structure and composition, down and dead woody material, and snags that occur after the fire can all affect wildlife. In particular, the loss of down and dead woody material and snags during a prescribed burn remove essential structural habitat components for a variety of wildlife and reduces species diversity (McMahon and deCalesta, 1990). Depending on the season, a fire can also have adverse effects on a species' nesting or reproductive success. The nature of the fire, e.g., its severity, patchiness, whether it is a crown or understory fire, etc., will also determine if ground-dwelling or canopy-dwelling species are affected. If wildland fires burn extensive areas, and/or the fire is of high intensity, entire populations or subpopulations of wildlife can be affected.

Wildlife can also benefit from fire. For instance, populations of species dependent on early seral stage vegetation increase following a burn. Vegetation that grows in the first 2-10 years after a burn often contains higher levels of nitrogen, which can cause increases in some herbivore populations. Decreased cover can improve the growth of forage and can improve predator hunting success. Decreased parasite loads and increased dispersion in some species can diminish disease levels. Fire, depending on its severity, can either increase or decrease the availability of tree snags, which are used by many species for nesting, for shelter, and for foraging.

Fires that are patchy - those that result in a mosaic of burned and unburned or lightly burned areas - will maintain more heterogeneous environments with broader faunal diversity than will larger-scale, high-intensity fires that burn over large areas. Hot, stand replacing fires, which become more likely with increased fuel loads, will have entirely different impacts on the landscape and the fauna within it than will patchy or less intense fires. Intense hot fires can type change the vegetation, e.g., a forest to brush/grassland change after a severe fire can have a long-term adverse impact on fauna that thrive in dense forest habitat. Patchy low intensity fires do not dramatically alter landscapes and remaining unburned vegetation provides habitat for existing species and impacts are relatively minor and short-term. Lack of fire and the resultant late seral stage vegetation will encourage species that thrive in such environments (see subsections on each class of wildlife below) at the expense of species favoring early or mid-seral habitats. Evidence suggests that maintenance of a variety of successional stages with patchy fire patterns ensures the highest levels of wildlife biodiversity (Nichols and Menke, 1984).

Invertebrates, Amphibians, and Reptiles

Direct lethal effects of fire on wildlife, in which animals are destroyed by incineration or asphyxiation are generally considered to be limited to smaller, relatively immobile species. In the Seashore, less mobile species include invertebrates, amphibians, and reptiles include the federal threatened red-legged frog. While most invertebrates that live in the surface soil layers and invertebrate eggs are likely to be killed by fire, some, including ants and flying surface insects, may increase in numbers after a fire. Fire may injure trees and encourage decay, attracting a variety of wood-boring insects that in turn attract insectivorous birds, such as woodpeckers.

Because amphibians and their eggs have evolved in moist environments and often require forest debris as habitat, fire impacts are a consequence of loss of litter and changes in water quality. Reptiles that occupy heat refugia during the day are usually not directly affected by fire. Along with reptiles, most amphibian populations show little response to mixed severity understory fires although species favoring open habitats are clearly favored in the first few years after a fire, before understory and shrub vegetation regenerates (USDA, 2000). The park has 28 species of reptiles and amphibians; however because the limited number of acres treated (500 acres prescribed burns; 500 acres of mechanical treatment under alternative A, the effect of the overall impact would be adverse, minor, and short-term. The impact to amphibians would be minor because effects would be localized and not burning riparian areas will provide protection zones, and impacts would be short-term because populations are expected to rebound within two years.

Fisheries and Aquatic Species

For fish, the primary concerns relative to fire are increases in water temperature and sediment, and the long-term loss of woody debris from stream channels. The most long-lasting and severe effects on fish habitat from fire occur when it is associated with the loss of streamside forest (McMahon and deCalesta, 1990). Of concern are the effects of burning in or near headwater channels that facilitate the transport of sediment and debris downslope into fish-bearing streams when stream networks expand during periods of high runoff.

Fire may affect the abundance and diversity of fish habitat and populations in streams by affecting the composition and structure of riparian vegetation and influencing water quality and quantity in a stream (McMahon and deCalesta, 1990). Loss of riparian vegetation can lead to elevated water temperatures, reducing the ability of the water to hold dissolved oxygen. The most susceptible species to these potential impacts are the federally listed coho salmon and steelhead trout. However, stream buffers of 100 feet would be left along creek areas to ensure impacts are mitigated to an acceptable level.

Birds

Because they are mobile, birds are usually affected only by changes in habitat following a fire, except during the nesting season, March 15 through July 15. Fire in California shrublands and forests have been shown to maintain or increase avian species diversity but to alter species composition. Some species, such as California quail, Swainson's thrush, scrub jay, and certain owls (northern spotted owl, see below) are known to decline in the first few years after fire (Lawrence, 1966, Lyon and Marzluff, 1985). Other species such as raptors, woodpeckers, and other owl species (burrowing, western screech) have been shown to increase in numbers after fires (USDA, 2000). Species adapted to early seral stages would clearly be favored. Ground - dwelling birds in the park such as California quail, northern harrier, and savannah sparrow - would be short-term negatively impacted by most fires while canopy-nesters such as red-tailed hawks, white-tailed kites, sparrow hawks, and ravens - would be negatively affected only by crown fires. Because prescribed burns are conducted primarily after the nesting season and regrowth occurs within months these impacts should be short-term and minor. Because snags are such an important determinant of avian diversity and abundance, the variable consequences of fire intensity and patterns on snag numbers would result in variable persistence of cavity nesters and those species which feed on wood-boring insects (USDA, 2000).

Mammals

Most mammals, because of their ability to escape the direct heat and smoke of fires, are only affected by the consequences of fire to vegetation, water and cover. During the first few growing seasons after a fire, improved vegetation growth usually provides increased food for herbivores (Ahlgren and Ahlgren, 1960). Reduced cover can provide increase risks for prey species, increased availability of seeds for small mammals and increased hunting opportunities for predators. Some species of rodents are known to decrease after stand-replacing fires, including the Western harvest mouse, brush mouse, and woodrat species (Schwilk and Keeley, 1998). Other species are known to increase after such fires including pocket gopher and deer mouse species (Sims and Buckner, 1973, Kaufman et al., 1988). Carnivores that depend on any of these impacted species would be similarly impacted. Ungulates often benefit from increased nutritional quality of recently burned vegetation, with positive impacts decreasing in five or more years post-burn. Fire may reduce disease rates in mammalian and avian populations by killing ground dwelling parasites and causing dispersion of individual animals, thereby reducing disease transmission (Peek et al., 1985). The park has 65 species of mammals from mountain lions, gray fox, brush rabbits, black-tailed deer, dusky-footed woodrats, deer mice, to pocket gophers and numerous species of bats. The majority of these species inhabit the four FMUs to be treated. Limantour FMU also has a small tule elk herd. Tule elk, brush rabbits, black-tailed deer, and other herbivores are expected to be positively impacted by fire and regrowth of vegetation. Dusky-footed woodrats, western harvest mouse shrews, and other small mammals are expected to have short-term impacts. Because the prescribed fires are cool, small areas that impacts are considered minor.

Alternative A

Under this alternative, 500 acres of prescribed burning and approximately 500 acres of mechanical treatment would occur over an average year. Treatment would be conducted within the Estero, Limantour Road, Highway One, and Bolinas Ridge FMUs. The only impacts to Tomales Point, Headlands, Inverness Ridge, Wilderness North, Wilderness South, and Palomarin FMUs would be from those actions common to all alternatives, such as road maintenance.

Analysis

For purposes of this analysis, the term wildlife includes fish and other aquatic species. The four primary activities associated with implementation of Alternative A, prescribed fire, wildland fire, fire suppression, and mechanical treatments can have adverse or beneficial impacts on wildlife, and these impacts can be direct or indirect. Impacts to wildlife are discussed primarily in terms of impacts to individuals, because the scale of the actions proposed within the plan are small enough that it is very unlikely that any wildlife populations or sub-populations would be affected. It is important to note, however, that unplanned large-scale wildland fire can affect populations as well as individuals, and from an ecological perspective, impacts to populations or subpopulations are considered more important than impacts to individuals.

Prescribed Fire

The primary use of prescribed burning under this alternative would be to reduce fuel loads along major road corridors to minimize unplanned ignitions, and to control non-native Scotch and French broom, as well as Monterey pine. No acreage would be burned to benefit wildlife, although in some cases burning may offer secondary benefits to wildlife. As noted above, fire can improve nutrient content of vegetation and restore habitat for some species of wildlife. It can also reduce the threat of catastrophic unplanned wildfire and the long-term destruction of habitat. Under Alternative A, prescribed fire would have beneficial, long-term, and minor impacts to some wildlife species from its effects in providing open or early seral stage habitat in areas of the Seashore most severely altered by fire suppression, and by continuing to reduce the risk of catastrophic fire, especially along roadways in the park. The benefits are no more than minor because the treated acreage would remain small, and would lie in large part along roadway corridors, where habitat is already disturbed by human activity and so is of lower quality for many species. Conversely, species that depend on down wood or dense forests, such as salamanders, some small mammals, and ground nesting birds would experience localized adverse impacts in the treated areas from displacement. Because only 500 acres would be burned and 500 acres are mechanically thinned, an abundant supply of down wood or more closed canopy woodlands would remain in the park, providing habitat for these species and preventing the impact to them of becoming more than negligible or minor and short-term.

Prescribed fires would be started when conditions are favorable for their control. This is often in spring or fall, which is outside of the dry season when most natural fires occur. This would have an adverse effect on species of wildlife that are adapted to the natural timing of fires, for example, small mammals that hibernate in leaf litter. Also, high levels of fuel loading in some areas of the Seashore may cause prescribed fires to burn at higher than natural intensities, even when fire prescriptions are designed to minimize intensity. Both the unnatural seasonality, and in some cases intensity, of prescribed fires could result in greater direct lethal impacts for immobile or hibernating species (USDA, 2000), such as invertebrates, amphibians or small mammals, than under a pre-European natural fire interval. Again, because the area treated is small, impacts to these species in the park would be no more than minor.

The activities involved in controlling prescribed fires, such as hand line construction, snag removal, water drops, etc., can have short-term adverse effects on wildlife. Because they are similar to (but less intense than) activities associated with controlling unplanned ignitions, they are discussed below.

Unplanned Ignitions, Wildfire, and Suppression

Fire suppression activities, such as construction and use of staging areas, helispots, or spike camps; construction of firelines using hand tools or bulldozers; cutting of snags; and mop-up can have adverse effects on wildlife. Maintaining control of prescribed fires can also involve hand line construction, snag removal, water drops, and other actions, but such efforts are likely to be much less intense, and have less impact, than they would be during wildland fire suppression.

Small species of mammals, reptiles, or amphibians can be injured or killed when vehicles are accessing sites or staging areas, or when bulldozers are constructing line. It is anticipated that in most cases these impacts would occur infrequently. Removal or trampling of vegetation in temporary staging areas used for suppression activities could adversely affect wildlife until vegetation in such areas regrows. Noise, dust, and light emanating from suppression staging areas could affect the use of surrounding habitats by wildlife. Spills of fuel, oil, hydraulic fluid, antifreeze, and other toxic chemicals at staging areas could affect wildlife, especially those in aquatic environments. Personnel at fire camps or on suppression crews could provide a source of human food to wildlife, resulting in conditioning of wildlife and in human/wildlife conflicts. These activities and the impacts they cause are discussed in greater detail below.

Dropping water or retardants on fires from helicopter buckets could result in a variety of impacts to wildlife. Water removed from small water bodies could have temporary seasonal impacts on aquatic organisms by reducing the size of wet or wetland habitat, or more serious and possibly permanent impacts on the inhabitants if the pond is completely drained or dried prematurely.

Transfer of water from one area to another can also have impacts to wildlife. For example, in the Sierra Nevada, chitrid fungus has been identified as a factor in the disappearance of mountain yellow-legged frog populations. Federal land management agencies in the region have expressed concern that helicopter buckets dipping in separate water bodies could add to the problem by spreading the fungus to currently non-infected populations of frogs. In Point Reyes, the use of several water bodies to fight a wildfire could result in the spread of non-native bullfrogs, which prey heavily on native frog species, or contribute to the spread of unknown pathogens or other exotic species.

The physical impact of a water drop could adversely affect individual animals through crushing. One advantage of water drops is in their use in some circumstances, instead of hand lines ("wet-lining") to control fire movement. This tactic would result in less impact to soil, forest litter, and vegetation than hand line construction and, therefore, would have less impact on wildlife, both in intensity and duration. Under Alternative A, the impact of water drops on wildlife would be adverse, long-term, and minor based upon possible impacts to aquatic ecosystems, especially in relation to amphibians. The potential impact is minor because the historic occurrence of unplanned ignitions has been only three per year and most do not involve water drops. However, if they did occur, the impact would be limited to a relatively small area. Water drops are not used in prescribed fire activities at the park.

Retardant drops have the same potential for physical injury, but may also be toxic, particularly in aquatic habitats. Studies have shown that the ecological effects of retardant and fire Suppressant Forms can be adverse to algae, aquatic invertebrates, and fish (Hamilton et. al., 1996). The low-flying aircraft could also disturb wildlife. Under Alternative A, impact to wildlife from retardant drops is expected to be negligible, adverse, and short-term because of its limited application in the park, and protocols for its use designed to protect aquatic resources.

Construction of helispots can result in the felling of trees and snags, which are potential wildlife habitat. Snags are especially important wildlife habitat. In addition, helicopter traffic would likely disturb wildlife, such as nesting raptors. Under Alternative A, the impact of helispots on wildlife is expected to be adverse, long-term, and minor, based upon their likely very limited use (if at all). With mitigation, limiting helispot construction and site helispots away from sensitive resources can reduce these impacts.

Fire crews staying in spike camps can have an adverse effect on wildlife by allowing them access to human food. This would lead to wildlife becoming conditioned to human foods and could result in human-wildlife conflicts. In such cases, animals often must be killed to protect human safety. Presence of hand crews in more remote areas would introduce an element of disturbance, which could affect sensitive species, such as nesting raptors. Under Alternative A, impacts to wildlife from spike camps are expected to be adverse, short-term, and minor. However, placing site spike camps away from sensitive resources and providing strict control of availability of food to wildlife at camps can reduce these impacts. Since spike camps are rarely used for prescribed fire activities, impacts are going to be adverse, short-term, and negligible.

Hand line construction would remove and disturb soil and forest litter, possibly affecting animals such as small mammals, amphibians, invertebrates, and ground-nesting birds. The presence of hand line crews in remote locations could cause direct disturbance of some wildlife species and introduce unnatural food sources (see spike camps above). Removal of forest litter and vegetation can also lead to soil erosion and increased siltation in adjacent lakes and streams. This could have an adverse effect on aquatic species, including invertebrates, amphibians, and fish. Impact of hand line construction in association with managed wildland fire and prescribed fire under Alternative A would be adverse, short-term, and negligible given the present limited amount of wildland fire and the limited use for prescribed fire (most line is cut by mowing only for prescribed fire).

Snags are an extremely valuable tree-form to some wildlife (Brown and Bright, 1997). They provide cavities and loose bark for nesting and roosting and food in the form of wood-boring insects. Any holding action that requires the felling of snags to protect human safety and the integrity of the fire line would potentially affect wildlife by reducing the availability of snags to species such as pileated woodpeckers and several bat species. Felling would likely kill some animals. The number of snags lost would vary, depending upon factors such as the type and age of tree stand, its history of fire and/or disease or insect infestation, and the intensity of the fire. Under Alternative A, snagging associated with holding actions for wildfires would potentially have minor, long-term, and adverse impacts because of the relatively small areas that would be affected (30 acres average per year).

Mop-up, or the churning of soil and forest litter to extinguish residual hot spots along the periphery of a fire, would cause some mortality of buried organisms by exposing them to heat and flames. Such impact, however, would be along short sections of the lined perimeter and affect few species. Impact of mop-up would therefore be adverse, short-term, and negligible for both prescribed burn and wildfires.

Mechanical Treatments

Mechanical fuel reduction techniques, such as mowing or brush clearing, can have adverse impacts on wildlife. Local mechanical treatments may affect ground-dwelling or brush-dwelling species by direct mortality or injury to individuals or their eggs, or by altering cover and food sources. Brush clearing can also increase foraging opportunities for some herbivores and predators.

Hand cutting of understory vegetation, down fuels, and small-diameter trees in the wildland/urban interface would have mixed effects on wildlife and habitat. Hand cutting trees and brush to attain target conditions provides a less woody and more natural habitat and helps reduce the threat of catastrophic fire; especially from human-caused ignitions that occur in developed areas. For a few species, such as ground and understory nesters and rodents, the loss of low-lying cover and more dense brush or small trees may have temporary impacts. However, other canopy nesters, avian predators, and several bat species would remain unaffected or benefit from a more open forest habitat. This type of habitat is less common in the park because of a history of fire suppression and fuel build-up. Creating more of it might result in species requiring this type of habitat moving into the thinned forests, with possible overall increases in species diversity in the area. Because no more than 500 acres per year are to be treated mechanically under Alternative A, the extent of adverse impacts to wildlife living in more densely wooded lands is likely to be negligible and short-term. If the same areas continue to be mechanically treated, the impact would be long-term. Negligible benefits would result to wildlife species requiring open habitats. Additional negligible benefits from a reduction in the risk of catastrophic fire in the treated area would also result from this alternative.

Short-term adverse impacts to wildlife during hand-thinning and mowing operations include human presence and use of chainsaws and other tools during thinning operations. Chipping would have the same effects. These actions may disturb wildlife, although such disturbance would be short-lived and negligible.

When removed biomass cannot be burned on site or removed for logistical, administrative, or ecological reasons, it may be chipped and distributed over the site. When chips are spread deeply enough to affect the growth of native plants, wildlife would be adversely affected. Such impacts, however, would be limited to areas adjacent to roads and developed areas, and standard mitigation for chipping calls for chips to be spread as thinly as possible on the site - usually to a depth of not more than 1 inch. Impact to wildlife from chipping would therefore be negligible, adverse, and short-term

Piling and burning of downed trees and shrubs may have an adverse effect on some wildlife. Some species, such as small rodents and reptiles, may take up residence in burn piles between the time they are stacked and the time they are burned; which can be several months. Many of these animals are likely to escape fire once the piles are ignited, but some may perish.

Fire Information/Education

Impacts associated with fire information and education would largely be indirect, beneficial, although highly dependent on the nature of the fire management action. Pre-planned events such as prescribed fires and mechanical treatment provide the opportunity to demonstrate the effectiveness of natural resource management to local communities and the interested public. During unplanned events, such as wildfires, time for effective communication is often more limited and can be more controversial since resources are often damaged. However, the effects of education usually do not have a direct effect - positive or negative - on impacts to wildlife. In some cases, education can be used to enforce a closure of an area to ensure wildlife quickly recovers.

Fire Cache/Park Headquarters Relocation, and Construction

The construction of a fire cache at Bear Valley would have no influence on the direct effects of fire management actions on wildlife. However, relocating fire management personnel to a more centralized location would allow for faster response time to natural resources in the event of wildfires.

No adverse or beneficial indirect effects are anticipated with the construction of the new fire cache. The building site is in the main developed area of the park at Bear Valley and heavily impacted. The site is a former trailer pad that was recently removed. There may be some short-term, adverse, negligible impacts to wildlife caused by noise during the construction.

Fire Effects and Fuel Management Research

No adverse or beneficial effects are anticipated on wildlife from the implementation of Alternative A research projects.

Cumulative Impacts

Cumulative impacts to wildlife could occur from construction or compaction from activities described in Appendix C, or from a large-scale wild fire. When considered in combination with the minor to moderately adverse impacts of projects (except a large-scale fire) listed in Appendix C, the cumulative impacts from Alternative A would be adverse, short-term, and moderate. When the effects of a large-scale fire such as the 1995 Vision Fire and the high levels of fuel loading from lack of fire over the last 150 years, some areas in a large-scale wildfire may burn at higher than natural intensities. This could create extensive forest gaps, discontinuous habitat, and greater consumption of large woody debris than what would be expected under natural fire conditions. In addition, there would be a type conversion of habitat in some areas - forest to brush/grassland and some long-term loss of forest habitat. This change to habitat could have short-term major adverse impacts or long-term moderate impacts to wildlife in the burned area. For example, the Vision Fire had a major adverse effect on mountain beaver, but the population is slowing recovering (Fellers, 2003)

Extensive burned areas that may be continuous from ridgeline to slope bottom and include riparian areas also characterize high-severity fires in Point Reyes. In addition, sediments loads would be expected to be at least twice the normal load under normal natural conditions (Ketcham, 2003). The sediment loads and lack of riparian vegetation would have adverse, moderate, long-term impacts (more than two years) to fish and aquatic species. However, vegetation would return in the long run, as it has following the 12,000+ acre Vision Fire, and erosion overland flow would return to rates within the natural rate of variability, preventing long-term impairment of park resources.

In summary, suppression impacts from a large fire would be adverse, moderate, and long-term. Changes to habitat would have an adverse, long-term, moderate to major effect on wildlife, but negative effects would be reversed in the long-term.

Conclusions

Under Alternative A, prescribed fire would have a beneficial, short- or long-term minor impact on wildlife by creating more open habitat and reducing the risk of catastrophic fire. A similar adverse, short-term minor impact on species using existing down wood or dense forest habitat is also likely.

Mechanical treatment would also offer short- to long-term negligible benefits to wildlife species requiring early seral stage habitat, and have adverse short- to long-term negligible impacts on some forest dwelling wildlife. The machinery used for chipping and shredding would be loud, which would have negligible, short-term impacts to some species, such as nesting birds, through disturbance.

Some suppression activities or actions to control prescribed burns, such as spike camps, access or creating fire lines, would have short-term adverse and therefore minor impacts on wildlife. Others, such as creating helispots or the use of helicopter buckets of water or retardants, may have longer lasting impacts. Overall, these activities are not expected to have more than minor impacts to wildlife. Actions to suppress large fires would likely be more intense, with short-term major or long-term moderate adverse impacts to wildlife.

No impairment to park wildlife would occur from implementing Alternative A.

Alternative B

Analysis

Prescribed Fire and Suppression

In this alternative 1000 acres of prescribed burning would occur over an average year. As in Alternative A, the primary purpose of burning would be to reduce fuels and the chance of a catastrophic wildfire. Wildlife would therefore primarily be the recipient of secondary benefits related to the creating of early seral stage or more open habitat, which is now quite rare, or of a reduced risk of large-scale unplanned fires. However, Alternative B would also include some small-scale test burns in Douglas-fir and Bishop pine forests to determine the effects. This may later lead to larger-scale prescribed burns and improved habitat in these heretofore untreated areas, with additional benefits for wildlife native to these forests. In addition, Alternative B includes burning in the Palomarin fire management unit to control the encroachment of Douglas-fir forest on what is now coastal scrub habitat in the Point Reyes Bird Observatory field station. This would help continue to maintain a mosaic of habitat for a variety of bird species, and should improve both habitat and species diversity, a moderate localized benefit to wildlife relative to Alternative A, but negligible or minor benefit relative to the entire study area.

As in Alternative A, prescribed fire would have a beneficial, long-term, minor impact on wildlife compared to the entire study area because this action provides habitat improvement in areas where natural fire cycles have been severely restricted by fire suppression and some reduction in the risk of catastrophic fire. When compared to the entire study are, the effects are comparatively minor because benefits are limited by the relatively small number of acres (1000) treated. Also, because the burn units are dispersed throughout the park in the various FMUs (no concentration of impacts within a watershed and only 10% or any watershed would be treated annually), the total acres treated in relationship to the 90,000 acres within park boundaries is still relatively small (approximately 1%).

However, the number of acres treated and resulting benefits to wildlife would be twice those of Alternative A. In addition, Alternative B treats acreage in four more FMUs - Inverness Ridge, Wilderness North, Wilderness South, and Palomarin - not treated in Alternative A. As noted above, compared to the entire study area or entire park, benefits are minor. But, compared to beneficial impacts resulting from the 500 acres burned in the No Action alternative, Alternative B could offer moderate short- to long-term positive impacts to wildlife.

Fire suppression activities and those needed to maintain control of prescribed fires would result in the same types of direct and indirect impacts described above for Alternative A. These include injury or death from heavy equipment or vehicles accessing a site; removing vegetation for staging areas or hand lines; noise, dust, and light from staging areas; accidental spills of fuel or other chemicals; the use of helicopter drops of water or retardants; noise from low flying aircraft or helicopters; and the construction of helispots. Fire crews occupying an area would also disturb wildlife and could result in the conditioning of some individual animals to the presence of humans. Indirect impacts would also be similar to those described above for the No Action alternative, and could include increased erosion of soil and siltation of lakes or streams and the loss of snags as habitat.

Although these adverse effects on wildlife from prescribed fire would occur over 1000 acres, they would remain minor and short-term in the context of the entire study area. However, they may be quite noticeable on a localized basis, and compared to the No Action alternative, may be locally moderate.

As in Alternative A, suppression actions from small-scale wildfires would potentially have minor, long-term, and adverse impacts because of the relatively small areas that would be affected. The impacts are identical to Alternative A as the acreage of wildfires that the park suppressed in an average year is not expected to change.

Mechanical Treatments

Under Alternative B, the total acres treated by mechanical means would increase to 1000. No mechanical thinning specifically to benefit wildlife would be undertaken; therefore benefits or adverse impacts from mechanical treatment would be related primarily to the increased acreage treated. Although twice the acreage as in Alternative A would be thinning, this is still a relatively small (approximately 1%) percentage of the 90,000 acres in the study area. In addition, treatment would be dispersed among seven FMUs (Alternative A would include mechanical treatment in three FMUs). The FMUs to receive additional treatment over Alternative A are Tomales Point, Wilderness North, Wilderness South, and Palomarin. Although this may provide some additional benefits to the tule elk population in the Tomales Point FMU, in the context of the entire study area, benefits to wildlife from mechanical treatment would likely be short- to long-term (depending on whether the same areas would be routinely treated) and negligible to minor.

The secondary benefits of clearing down wood or thinning branches to those species requiring more open habitat could be much more noticeable in some locations and compared to these same benefits in Alternative A. This is also true of adverse impacts associated with the thinning activities themselves, as well as from the loss of dead logs or other habitat for forest dwelling species. Either localized benefits or adverse impacts could range from minor to moderate compared to those related to Alternative A.

Fire Information/Education

As in Alternative A, the impacts associated with fire information and education would largely be indirectly beneficial, although highly dependent on the nature of the fire management action.

Fire Cache/Park Headquarters Relocation, and Construction

As in Alternative A, the construction of a fire cache at Bear Valley would have no influence on the direct effects of fire management actions on wildlife. There may be some short-term adverse, negligible, impacts to wildlife caused by noise during the construction.

Fire Effects and Fuel Management Research

No direct adverse or beneficial effects are anticipated on wildlife from the implementation of Alternative B research projects. However, depending on the results, test burns may result in the creation of additional open or early seral stage habitat in Douglas-fir or Bishop pine forests.

Cumulative Impacts

No cumulative impacts beyond those described for alternative A would occur.

Conclusion

In the context of the 90,000 acre study area, the impacts to wildlife of Alternative B would be nearly indistinguishable from Alternative A. Treatment with prescribed fire and through mechanical means would result in short- to long-term, negligible to minor benefits to wildlife from the reestablishment of the natural fire cycle, reduction of fuel loads, and reduction of the potential for catastrophic wildfire. However, compared to No Action, Alternative B could offer moderate short- to long-term benefits to wildlife because twice as many acres would be treated (2000 total; 2% of total acres managed) and noticeable on a local scale. Forest dwelling species would suffer negligible to minor short-term adverse impacts from reductions in habitat overall, and minor to moderate impacts relative to those from the No Action alternative.

Some suppression activities (retardant use) or actions to control prescribed burns, such as spike camps, access or creating fire lines, would have short-term adverse and therefore minor impacts on wildlife. Others, such as creating helispots or the use of helicopter buckets of water or retardants, may have longer lasting impacts. Overall, these activities are not expected to have more than minor impacts to wildlife. Compared to Alternative A, the degree of impact from actions to prepare for or control prescribed burns would be greater. Since all of these actions are those associated with short-term, more controlled minor impacts, it is unlikely that more than moderate adverse impacts compared to Alternative A would occur. As in Alternative A, actions to suppress large fires would likely be more intense, with short-term major or long-term moderate adverse impacts to wildlife.

In the context of the entire study area, Alternative B would result in negligible to minor short- to long-term benefits to wildlife from creating open habitat using mechanical thinning. Compared to Alternative A, these benefits could be moderate.

No impairment to park wildlife would occur from implementing Alternative B.

Alternative C

Analysis

Prescribed Fire and Suppression

In this alternative 2000 acres of prescribed burning would occur over an average year. To the extent it is possible, prescribed burns would be conducted to approximate historic natural fire intensity and fire intervals. The intent is to allow the process of fire to act on the landscape as it has for thousands of years to the greatest extent possible, while ensuring human safety and protecting property. In both Wilderness North and Wilderness South fire management units, prescribed fire would be used to open up forested areas to increase forage for herbaceous wildlife. The goal under Alternative C is to reintroduce fire into forests in these FMUs that have historically burned on a regular basis (estimated fire return interval: 7-14 years), but which have not burned for 50-100 years. Fire would be used in the Tomales Point FMU to encourage the growth of native plant species, with expected positive effects on the Tule elk population in the area. Fire would also be used to help control non-native and highly invasive velvet grass in this FMU. As in Alternative B, prescribed burning in the Palomarin fire management unit would be used to maintain and improve habitat for a variety of bird species. Beyond these specific changes, Alternative C would simply treat a greater number of acres with the intent of reducing fuels and controlling non-native and invasive plant species than either of the other alternatives. As noted in the analysis of these alternatives, wildlife would experience benefits from these activities even though they are not specifically directed at improving wildlife habitat. These benefits include creating more open habitat, increase nutrition in forage, an emphasis on native plant species, some of which are likely to have been food for native wildlife species, and a decreased risk of large-scale catastrophic fires.

In this alternative, prescribed fire would have a beneficial, short- to long-term moderate impact on wildlife compared to the entire study area even compared to the entire study area. The effects would be noticeable because 2000 acres would be treated, and because the goal of this alternative is to return as much of the park's fire dependent vegetation as possible (given no more than 2000 acres per year would be treated) to its natural fire interval and intensity. As in other alternatives, burn units would be dispersed throughout the park in the various FMUs (no concentration of impacts within a watershed and only 10% or any watershed would be treated annually) and the total acres treated in relationship to the 90,000 acres within park boundaries would be relatively small (approximately 2%).

In another context, that is, related to the benefits of prescribed fire in the No Action alternative, Alternative C would treat four times the area. This combined with the focus of Alternative C on improving conditions for natural resources could result in major benefits on a local scale compared to Alternative A. If the treated areas are eventually returned to their natural fire cycles, wildlife may experience very long-term or permanent positive impacts.

Fire suppression activities and those needed to maintain control of prescribed fires would result in the same types of direct and indirect impacts described above for Alternative A. These include injury or death from heavy equipment or vehicles accessing a site; removing vegetation for staging areas or hand lines; noise, dust, and light from staging areas; accidental spills of fuel or other chemicals; the use of helicopter drops of water or retardants; noise from low flying aircraft or helicopters; and the construction of helispots. Fire crews occupying an area would also disturb wildlife and could result in the conditioning of some individual animals to the presence of humans. Indirect impacts would also be similar to those described above for the No Action alternative, and could include increased erosion of soil and siltation of lakes or streams and the loss of snags as habitat.

These activities would occur on 2000 acres per year, and may result in moderate adverse impacts, even in the context of the entire study area. On a localized basis, the impacts may be quite noticeable, and compared to the No Action alternative, may be moderate or even major in their intensity. Actions associated with controlling prescribed burns are likely to have less intense impacts of shorter duration than those needed to suppress wildfires. Construction of helipads or the use of helicopter drops for water or retardants could have long-term and more severe effects on wildlife.

Mechanical Treatments

Under Alternative C, the total acres treated by mechanical means would increase to 1,500. No mechanical thinning specifically to benefit wildlife would be undertaken; therefore benefits or adverse impacts from mechanical treatment would be related primarily to the increased acreage treated. Although three times the acreage as in Alternative A would be thinning, this is still a relatively small (approximately 1.5%) percentage of the 90,000 acres in the study area. In addition, treatment would be dispersed among the same eight FMUs as in Alternative B (Alternative A would include mechanical treatment in three FMUs). As in Alternative B, the Tomales Point FMU would receive thinning treatment, which may offer specific benefits for tule elk by improving the quantity and quality of forage available. Otherwise, the same type of benefits as described in the other alternatives of creating more open habitat and reducing the risk of catastrophic fire would occur if this alternative were selected. Because more acreage would be treated, benefits are likely to be minor to moderate. If treated areas continue to be treated, the benefits would be long-term.

The secondary benefits of clearing down wood or thinning branches to those species requiring more open habitat could be much more noticeable in some locations and compared to these same benefits in Alternative A. This is also true of adverse impacts associated with the thinning activities themselves, as well as from the loss of dead logs or other habitat for forest dwelling species. Either localized benefits or adverse impacts could be moderate compared to those related to Alternative A.

Fire Information/Education

As with other alternatives, fire information and education would largely be indirect and beneficial, although highly dependent on the nature of the fire management action.

Fire Cache/Park Headquarters Relocation, and Construction

As in other alternatives, construction of a fire cache at Bear Valley would have no influence on the direct effects of fire management actions on wildlife. There may be some short-term, adverse, negligible impacts to wildlife caused by noise during the construction.

Fire Effects and Fuel Management Research

No direct adverse or beneficial effects are anticipated on wildlife from the implementation of Alternative C research projects. However, depending on the results, test burns may result in the creation of additional open or early seral stage habitat in Douglas-fir or Bishop pine forests.

Cumulative Impacts

No cumulative impacts beyond those described for alternative A would occur.

Conclusion

Treatment with prescribed fire and through mechanical means would result in short- to long-term, minor to moderate benefits to wildlife from the reestablishment of the natural fire cycle, reduction of fuel loads, and reduction of the potential for catastrophic wildfire. However, compared to No Action, Alternative C could offer moderate to major short- to long-term benefits to wildlife because four times as many acres would be treated (2000 total; 2% of total acres managed) and be noticeable on a local scale. Forest dwelling species would suffer minor to moderate short-term adverse impacts from reductions in habitat overall, and moderate or even major localized impacts relative to those from the No Action alternative.

Some suppression activities (retardant use) or actions to control prescribed burns, such as spike camps, access or creating fire lines, would have short-term, adverse, and therefore minor impacts on wildlife. Others, such as creating helispots or the use of helicopter buckets of water or retardants, may have longer lasting impacts. Overall, these activities are not expected to have more than moderate impacts to wildlife. Compared to Alternative A, the degree of impact from actions to prepare for or control prescribed burns would be greater. Since all of these actions are those associated with short-term, more controlled impacts, it is unlikely that more than moderate adverse impacts compared to Alternative A would occur. As in Alternative A, actions to suppress large fires would likely be more intense, with short-term major or long-term moderate adverse impacts to wildlife.

In the context of the entire study area, Alternative C would result in minor short- to long-term benefits to wildlife from creating open habitat using mechanical thinning. Compared to Alternative A, these benefits could be moderate.

No impairment to park wildlife would occur from implementing Alternative C.

IMPACTS ON SPECIAL-STATUS SPECIES

Alternative A

The project area contains numerous plant and wildlife species that are nationally, regionally, or locally rare. These species span a spectrum of rarity from being federally listed as Endangered or Threatened under the Endangered Species Act, to being recognized by the California Native Plant Society (CNPS) or local area species experts as uncommon or rare. For purposes of this document, all of these species are collectively referred to as “special-status species.” These species all require consideration when management actions are taken to ensure that actions do not harm the species or their habitats.

Fire management activities have potential to affect many of these species. For example, stream or riparian species could be adversely affected by increased sedimentation in creeks and/or persistent turbidity following wildland or prescribed fire. Fire management activities such as cutting fire line or removing vegetation to reduce fuel accumulations could destroy or harm individuals or damage their habitat. Conversely, as is the case for common plants and wildlife, many special-status species in the project area are adapted to periodic fire, and application of fire to the ecosystems could benefit these species by providing a wider diversity of habitats, by stimulating seed germination, or by improving habitat for prey species.

In May 2001, in response to PRNS’s request to initiate consultation on revision of the park’s fire management plan, the U.S. Fish and Wildlife Service sent a list of Federally-listed Threatened and Endangered animal and plant species that may occur in the Project Area (dated 5/24/01). The following tables of special-status species (see Affected Environment) were generated from the USFWS list, from State of California lists, and from California Native Plant Society lists to facilitate this impact analysis:

Table 15. Federal Threatened, Endangered, Candidate, and Proposed plant species that may occur in areas affected by PRNS’s Fire Management Plan

Table 21. Federal Plant Species of Concern and California-listed plant species that may occur in areas affected by PRNS’s Fire Management Plan

Table 22. Additional Plant Species of NPS Management Concern known to occur in areas affected by PRNS’s Fire Management Plan.

Table 24. Federal Threatened, Endangered, Candidate, and Proposed animal species that may occur in areas affected by PRNS’s Fire Management Plan

Table 33. Federal Animal Species of Concern and California-listed animal species that may occur in areas affected by PRNS’s Fire Management Plan

These tables present summary information on whether or not the species are known to occur in PRNS and/or GGNRA and whether or not they are likely to be adversely impacted by fire management plan activities, based on PRNS's best professional judgment. Species listed in these tables were evaluated to determine whether or not fire management activities could affect either individuals of the species or their habitat.

Federally listed Threatened and Endangered Species Covered in this EIS

The following sections discuss probable impacts to species listed as threatened or endangered by the federal government that may occur from implementing actions in the fire management plan alternatives. All plant or animal species on this list and present in the project area were considered in the analysis.

PLANTS
Sonoma alopecurus (*Alopecurus aequalis var. sonomensis*)
Sonoma spineflower (*Chorizanthe valida*)
Tiburon paintbrush (*Castilleja affinis ssp. neglecta*)
Marin dwarf flax (*Hesperolinon congestum*)
Beach layia (*Layia carnosa*)
Tidestrom's lupine (*Lupinus tidestromii [var. layneae])*

WILDLIFE
Northern spotted owl (*Strix occidentalis caurina*)
California red-legged frog (*Rana aurora draytonii*)
Central California coho salmon (*Oncorhynchus kisutch*)
Central California Coast steelhead (*Oncorhynchus mykiss*)
California freshwater shrimp (*Syncaris pacifica*)
Myrtle's silverspot butterfly (*Speyeria zerene myrtleae*)
Western snowy plover (*Charadrius alexandrinus nivosus*)

Federally Listed Plants

For each federally listed plant species, Table 52 summarizes the most current information on the number of occurrences of the species in the project area and the population size trend that PORE botanists have estimated from available data. Narratives on each species status, potential impacts, and impact mitigation measures are presented following the table.

Table 52. Number of Occurrences and Estimated Population Trends for Listed Plant Species in the Project Area

Species	# of Occurrences in Project Area	Population Trends
PRNS		
Sonoma alopecurus (E) *Alopecurus aequalis var. sonomensis*	4	Unknown – need more data
Sonoma spineflower (E) *Chorizanthe valida*	2	Stable or increasing
Beach layia (E)	13	Stable

Layia carnosa		
Tidestrom's lupine (E) *Lupinus tidestromii* (var. *layneae*)	7	Stable
North District GGNRA		
Tiburon paintbrush (E) *Castilleja affinis ssp. neglecta*	1	Stable
Marin dwarf flax (T) *Hesperolinon congestum*	6	Increasing

a/ Population size trends are based on very limited data as described in the following sections.

Sonoma alopecurus (Alopecurus aequalis var. sonomensis) – Endangered

Sonoma alopecurus, a perennial grass that grows in the park on pastures in agricultural areas, favors moist or wet sandy soils. Results of monitoring at the Seashore suggest it thrives in wetlands that are grazed just enough to reduce competing vegetation. New occurrences of alopecurus may be found in areas of seasonally saturated soils as rare plant surveys continue. Such areas are most common in, but not exclusive to, the relatively gentle topography of the west-central Point Reyes peninsula.

As noted in Affected Environment, the four known locations of this species consist of populations ranging from about 600 to more than 8000 individuals. The G Ranch population is located in a back dune area near the southwest corner of Abbott's Lagoon, in a swale that supports freshwater marsh vegetation. As of 2000, a systematic survey found a peak population size of over 1,500 individuals. By 2003, the population had increased to over 8,000. The H Ranch population is in a freshwater marsh/swale along a fence that borders an ungrazed area south of Abbott's Lagoon. Immediately above a small berm carrying the trail across the swale is a population that numbered 60 in 2000, but which has now grown to more than 600 plants. A third population of 50+ plants on F Ranch was discovered in 2000 in a wetland swale between semi-stabilized dunes. In 2003, this population numbered more than 1000. The fourth population exists on a 521 acre tract recently purchased by the NPS from AT & T and currently leased for cattle grazing. Two patches occur on this tract, and together they numbered over 3,500 plants when last surveyed in 2003.

The long-term population trend for this species is unknown, as two of the populations were recently discovered, and more intense monitoring and surveying of the remaining two populations was not completed until 2000. Additional monitoring over time of these populations, and a broad based survey of the study area for as yet undiscovered populations is needed to know whether the population park-wide is stabilized, or is increasing or decreasing in size. However, in the short-term all four populations have increased from the year 2000 to 2003.

Because all known populations of Sonoma alopercurus in the park lie within the Minimum Management Fire Management Unit (a former population in the Palomarin FMU has been extirpated), they would not be subject either to prescribed burning or mechanical fuels treatments. The populations could be adversely affected by an unplanned wildfire or by suppression activities associated with such a fire, but this is considered unlikely given they occur in wet sites within pastures routinely grazed by cattle where fire is unlikely to carry.

Sonoma spineflower (Chorizanthe valida) – Endangered
Sonoma spineflower was thought to have been extirpated in Marin and Sonoma counties from agricultural and residential development, but was rediscovered in the park in 1976 in the same pasture on G Ranch in which Sonoma alopecurus is located. Coarse estimates of size indicate this population size has grown from several hundred plants in 1983 to 30,000 plants in 1993. The Marin Chapter of California Native Plant Society has actively searched other areas for this plant since its 1980 rediscovery without success, and it is considered unlikely that other populations of spineflower would be found.

As noted in Affected Environment, the park has attempted to establish new populations by seeding grazed pastures in several locations in the park. To date, one population has been successful, and a second appears to be taking hold. Overall, the population in the park appears to be stable and increasing.

As with Sonoma alopecurus, all known populations of Sonoma spineflower are growing in the Minimum Management Fire Management Unit, where no fire management activities are planned. Although it is possible they could be subject to impacts associated with an unplanned wildfire or its suppression, it is considered unlikely given their location in a wet and low fuel (e.g., grazed) environment.

Tiburon paintbrush (Castilleja affinis ssp. neglecta) – Endangered and Marin dwarf flax (Hesperolinon congestum) – Threatened
Both Tiburon paintbrush and Marin dwarf flax are species that grow in the serpentine soils and rocky outcrops of Nicasio Ridge at the northern border of GGNRA's North District. Tiburon paintbrush is a semi-woody perennial; recent data suggests the population may be in decline (see Table 17). Marin dwarf flax has been found in six locations on Nicasio Ridge, and overlaps at one point with Tiburon paintbrush in and near the McIsaac Ranch. The abundance of Marin dwarf flax on Nicasio Ridge varies from year to year, and new populations were found in 1999 and 2000. This suggests the distribution of Marin dwarf flax on Nicasio Ridge is not fully known, and that it may appear in other sites in the future due to seed dispersal, weather, or localized disturbances.

All of the occurrences of Marin dwarf flax and Tiburon paintbrush are within the Minimum Management Fire Management Unit, and would not be subject to either prescribed burning or mechanical fuels treatments. The populations could be subject to impacts associated with an unplanned wildfire or by fire suppression activities, but this is unlikely because the populations occur on rocky outcrops where fire is unlikely to carry.

Beach layia (Layia carnosa) – Endangered and Tidestrom's lupine (Lupinus tidestromii) – Endangered
These two plant species occur in coastal dunes on the western edge of the PRNS peninsula. Both have been monitored by CNPS volunteers and PRNS staff since the 1980s. Monitoring reports include an estimate of plant numbers, a description of site characteristics, and apparent threats to each occurrence. These reports have been assembled in the PRNS Rare Plant Database.

Beach layia has been recorded at both dune and pasture sites in the park. Its habitat is the central foredune community, which, because of dune blowouts and restabilization, can cause large fluctuations in plant numbers and local distribution. Table 19 in Affected Environment shows this is true for populations in the park. Some patches of beach layia in the park are considered threatened by the presence of non-native invasive species such as European beachgrass (*Ammophila arenaria*), sea fig (*Carpobrotus chilensis*), and/or Hottentot fig (*Carpobrotus edulis*) nearby.

Tidestrom's lupine also occurs in seven dune and pasture sites in the park. The largest population at the Seashore is located behind dunes southwest of Abbott's Lagoon. Others are located north of Abbott's Lagoon and further south, near the North Beach parking area and the Old Lifesaving Station. Three of the seven occurrences in the park are located in pastures, but as with beach layia, grazing is not considered a threat to their continued existence. Six of the populations are considered threatened by European beachgrass and ice plant. The total number of individuals has increased in the last three years, from an estimated 8,000+ in 2000 to nearly 200,000 in the year 2002. The population is considered stable.

All of these occurrences are within the Minimum Management Fire Management Unit, and would not be subject to either prescribed burning or mechanical fuels treatments. The populations could be subject to impacts associated with an unplanned wildfire or by fire suppression activities, but this is unlikely because the populations occur in sandy dunes surrounded by pastures routinely grazed by cattle where fire is unlikely to carry.

Other Special Status Plant Species

Table 21 in Affected Environment (of all plant species) shows several plant species in the affected area are listed as federal Species of Concern. Species of Concern are those where USFWS is collecting additional information to determine whether they warrant consideration for future listing. In addition, three species (Point Reyes blennosperma, Marin Manzanita, and Bolinas ceanothus) are considered rare by the state of California, one is state endangered (Point Reyes meadowfoam) and all plant species in the table have been watchlisted by the California Native Plant Society. In Alternative A, although no federal or state listed species have been found in FMUs that would be treated with prescribed fire, one state rare species (Bolinas ceanothus) is present in the Bolinas Ridge FMU. Bolinas ceanothus does not occur in any FMUs slated for mechanical treatment in this alternative. Several federal species of concern are present in Estero and Limantour Road FMUs, which would be treated with both prescribed fire and mechanical thinning. Because these species are not listed or proposed for listing as threatened or endangered by the state or federal government, they are treated together below.

<u>Analysis</u>

Under Alternative A, 4 FMUs - Estero, Limantour, Highway One, and Bolinas Ridge - are treated with prescribed fire. Three of these - Estero, Limantour, and Highway One FMUs - would also be treated mechanically.

Prescribed Fire

The effects of fire on the species listed in Table 21 are not fully known. However, the park's mean surface fire intervals of 7 to 13 years (Brown et al., 1999) indicate fire is an integral part of the natural ecosystem at Point Reyes. Research has demonstrated that fire plays a critical role in the management of many threatened and endangered species in areas with regular burn intervals. For example, fire helps maintain open areas, can stimulate or is required for reproduction, and removes non-native competitors. Ceanothus, for example, is most often a fire dependent genus. Even though individuals of some species of concern may be killed by prescribed fire, the removal of competitors has a long-term beneficial effect as fire dependent native species return, while the competitors often do not (National Biological Service, 1995).

Because prescribed fire would be limited in scope, it would not involve a large component of the total population of each species of concern. This means both the potential for adverse or beneficial impacts would be no more than minor. Adverse impacts would be short-term for the most part, but beneficial impacts may be long-term.

Unplanned Ignitions, Wildfire, and Suppression

Wildland burns may have the same type of effects as prescribed burning, but may also cause type conversions or help facilitate the spread of exotic species. Suppression activities during a wildfire would also potentially result in crushing, shearing, or destruction of unburned individuals of some of the species listed in Table 21 or indirect effects on these same species through soil compaction. The average acreage burned by wildfire in the study area is less than 30 acres; because it is small in scope, the chance of wildfire or suppression in an average year having more than a negligible or minor adverse impact is low. Impacts may be short- or long-term depending on the intensity of the fire or location and extent of suppression activities.

Mechanical Treatments

Mechanical thinning activities such as mowing are not expected to have any adverse impacts on the special status species on Table 21. This is because mowing would be done in the fall after plants have flowered and gone to seed, and rare plants populations would be excluded from treatment areas. Areas are surveyed each year before they are treated to determine whether any special status plants exist on site.

Fire Information/Education

No impact to any plant special status species is expected from the distribution of fire information or education.

Fire Cache/Park Headquarters Relocation, and Construction

Because the area where the fire cache is planned would be surveyed prior to construction, impacts to protected plant species would be minimized. It is possible that individuals would be affected, but the extent of the effect would be minor.

Fire Effects and Fuel Management Research

No effects to any special status plant species from fuel management research under Alternative A are expected.

Federally Protected Wildlife

Northern Spotted Owl (Strix occidentalis caurina) - Threatened
The northern spotted owl (*Strix occidentalis caurina*) was federally listed as threatened in 1990 (USFWS, 1990). Most nesting and roosting sites occur in older, decadent stands of conifer and hardwood trees with large overstory trees, and about 35,000 acres of potential habitat exists in the study area. A recent census estimated a population of approximately 49 owl activity centers (Chow, 1997, Fehring et al., 2001, NPS, unpubl. data). Data on the number of activity centers collected since 1998 appears to indicate a stable population.

While the acreage in the study area is not designated critical habitat for the spotted owl, this is only because the species is already considered protected by virtue of the lands designation as National Park status. In addition to protection offered by NPS policies, the Seashore is implementing the following mitigation measures to minimize any adverse impact from prescribed or wildland fire, or from mechanical treatment.

Mitigation Measures Routinely Used for Activities in Spotted Owl Habitat

- annually identify and map areas where spotted owls are nesting,
- protect occupied and previously used nest sites from unplanned ignitions,
- do not conduct prescribed burns within 400 meters of an occupied or previously used nest site,
- do not conduct mechanical treatments with mechanized equipment within 400 meters of an occupied or previously used nest site between February 1 and July 31 (breeding season), and
- conduct post-treatment monitoring to ascertain any impacts.

Analysis

Under this Alternative, potential effects on northern spotted owls are extremely limited because only two of the FMUs to be treated - Highway One and Bolinas Ridge - are considered habitat.

Prescribed Fire

Under a natural fire regime, spotted owl habitat in the project area was subject to periodic, low-intensity fires. However, fire in the study area has been suppressed for 150 years, and high fuel loadings make large, stand-replacing fires possible. These hot fires can result in type conversions and the loss of spotted owl forest habitat for many years.

Prescribed fire can be an effective tool in protecting and improving spotted owl habitat in the park by helping to reduce unnatural accumulations of fuels and ladder fuels. Spotted owls can coexist with extensive fires of varying intensities within their habitats (Weatherspoon et al., 1992). Because of the existing high level of fuel loading in many areas of the park, even fires that are burning within prescription are likely to burn small areas at intensities high enough to have an adverse effect on some spotted owls by reducing prey items. This is no more than a negligible or minor, short-term, adverse impact, however, especially compared to the increased risk and relatively serious impacts of wildland fire under a regime of fire suppression.

In the old growth stands favored by spotted owls, the dense canopies maintain a higher relative humidity, which reduces heating and drying of surface fuels, thus reducing flammability. Adverse effects from wildland fire would be minimized if fuel loads were reduced in and near spotted owl nesting and roosting areas. This could be done by application of spring prescribed fires that would disrupt fuel continuity and reduce the potential for stand-replacing fires (Weatherspoon et al., 1992).

Adverse impacts on spotted owl territories that are identified prior to ignition of a prescribed fire would be minimized through preparatory burns and mechanical fuel reduction in nesting and roosting habitat to control fire intensity in these areas. In addition, no treatment would occur within 400 meters of a nesting or known roosting site to mitigate any potential impacts. Prescribed fire planning also takes into account other important habitat components, such as down, woody debris that provide habitat for dusky-footed woodrats, which are an important prey species for northern spotted owls in the project area. Fires of an intensity that would reduce the amount of woody debris, or would otherwise adversely affect woodrat habitat or nests would have an indirect minor short-term adverse effect on spotted owls.

Currently, no program elements exist for the management of prescribed fires for the benefit of spotted owls. The use of prescribed fire under Alternative A, would, nonetheless, have a beneficial, long-term, and minor impact on California spotted owls, primarily through reduction in the threat of catastrophic fire in some areas.

Unplanned Ignitions, Wildfire, and Suppression

As noted above, high fuel loadings make hot fires or hot spots within lower intensity prescribed burns more likely. These hot fires can have adverse impacts on habitat by reducing canopy closure or destroying owl prey or their habitat. However, given that the average annual acreage burned from wildfires at the park is quite low, any more than minor adverse impacts from average annual wildland fires are unlikely.

Mechanical Treatments

Under Alternative A, hand thinning or mechanical treatments in the vicinity of development and roads such as on Bolinas Ridge and Highway One FMUs could have an adverse effect on spotted owls through a reduction in canopy closure. This is especially true where developed areas interface with dense forest that provides roosting and nesting habitat. Under Alternative A, cutting large trees would be limited because techniques would be confined to hand thinning and then piling and burning. In some areas, clearing understory vegetation could, in fact, improve foraging conditions for spotted owls and habitat for woodrats.

Chipping is conducted occasionally in this alternative. Chipping involves cutting material and then distributing it over a site where air quality, visitor use, or other management concerns prohibit burning. The equipment used to chip material is extremely loud and, if operated nearby, may disturb spotted owls. Because only a maximum of 500 acres would be treated with mechanical equipment and because only two of the FMUs proposed for mechanical treatment include spotted owl habitat, the impact would be a minor, short-term, adverse one on the owl population in the park.

Fire Information/Education

No impact to spotted owls from the distribution of fire information or education is expected.

Fire Cache/Park Headquarters Relocation, and Construction

The fire cache would not be located in the vicinity of spotted owl activity centers or potential habitat, so no impact is expected.

Fire Effects and Fuel Management Research

No effects to spotted owls from fuel management research under Alternative A are expected.

Red-legged Frog (Rana aurora draytonii) – Threatened

The study area supports one of the largest known populations of California red-legged frogs in the state. A comprehensive survey of aquatic habitat in the study area has located numerous sites in riparian areas, wet swales, seasonal springs, and stock ponds on ranch lands. The survey is ongoing, and is expected to locate many more frog habitats in the Seashore and GGNRA.

PRNS, GGNRA, and adjoining areas of Marin County comprise one of the 57 core areas for focused recovery of red-legged frogs established in the Final Recovery Plan for the species (USFWS, 2002). Much of the project area falls within the recently established criteria for red-legged frog critical habitat (USFWS, 2002). For example, the central peninsula contains numerous stock ponds which retain water at least 20 inches deep well into the summer. Pond habitat and perennial creeks are also clustered, particularly at the Point. These concentrated aquatic habitats and the fact that ground between them is suitable for overland travel by frogs has created an interconnected and critical habitat for this species in the study area. A second interconnected habitat area extends along the Olema Valley, where the perennial segment of Olema Creek links scattered off-stream aquatic habitats from the vicinity of Point Reyes Station south approximately 13.5 km. Olema Creek runs through the Wilderness South and Highway One FMUs.

Red-legged frogs have also been found on Bolinas Mesa and at several ponds on top of Bolinas Ridge. Since frogs could be present in unsurveyed locations on Inverness Ridge, and could travel along seasonally wet riparian corridors over the ridge, all the red-legged frog sighting locations have been linked into one metapopulation.

Based on survey data, the most important riparian areas for red-legged frogs in the study area are those with a relatively low gradient that have late season water flow or water retention in pools. On Point Reyes itself, such creeks support relatively few of the documented occurrences of the frogs, but they may serve as connector and refuge habitats. The most important of these are Kehoe Creek and Abbott's Lagoon Creek on the north end of the peninsula, and Schooner Creek, which drains into Drakes Estero.

Analysis

The types of impacts fire management activities could have on red-legged frog aquatic habitats are summarized in Table 53, which is based on the Draft Recovery Plan.

Table 53. Potential Impacts on Red-legged Frog Aquatic Habitats from Fire Management Activities

Impact	Potential Effect on CRLF Habitat
Emergent vegetation removed.	Emergent vegetation necessary for amplexus and anchoring egg masses. Excessive levels may reduce sunlight needed for growth of algae, which is chief larvae food.
Shading vegetation removed (emergent and bank side)	Chiefly harmful to adults, for whom shaded refugia may be critical in drier inland areas during the summer.
Insect habitat vegetation removal	Harmful to adults and juveniles that mainly feed on invertebrates for which bank side vegetation is prime habitat.
Excess water drawdown in ponds	Leave egg masses stranded on vegetation
Change hydrological regime by accelerating runoff	Pools may dry before metamorphosis completed

Nearly all of these potentially adverse impacts would result from wildland fire suppression activities or from a wildfire itself. This is because all prescribed burn plans and plans for mechanical treatment in a given year are reviewed and any important riparian areas or other habitat for red-legged frogs avoided. All fire management actions would adhere to a setback from breeding and non-breeding habitat for red-legged frogs

Prescribed Fire

The species appears to be thriving under the current PRNS management, including fire management actions that have been conducted over the past several years and will be continued under this alternative. Prescribed fire, because it is used to restore the natural vegetation structure in park habitats and reduce the risk of catastrophic fire, would have long-term benefits to red-legged frogs and their habitat. These benefits, however, would be limited by the relatively small area (500 acres) that would be burned annually under Alternative A in just four FMUs - Estero, Limantour, Highway One, and Bolinas Ridge.

High levels of fuel loading in some areas may cause prescribed fires to burn at higher than natural intensities, even when fire prescriptions were designed to minimize high-intensity fires. Hotter fires, or fires that may more readily burn unintended areas, could burn riparian habitat and have the effects described in Table 53 above. Higher intensity burns could also result in increased sedimentation in frog habitat. However, the extent of these types of impacts under the prescribed burn program proposed in this alternative would be quite small, or perhaps even largely non-existent. Adverse impacts to frogs would therefore be short-term and negligible because of the small amount acreage burned in each FMUs per year.

Unplanned Ignitions, Wildfire, and Suppression

Because unplanned ignitions may burn in frog habitat, some of the types of impacts identified in Table 53 above could result. Suppression activities - water drops, line construction, retardant drops - could also inadvertently have adverse effects on red-legged frogs, but because of the small acres (30 acres) of wildfire each year, the effects are expected to be short-term and negligible.

Mechanical Treatment

Mechanical treatment such as hand thinning, line construction, and pile burning could disturb frogs or alter their habitat. Frogs may shelter in piles and be killed when they are burned. However, the impact to the park's frog population would be no more than negligible because breeding areas and adjacent non-breeding areas would be identified and avoided before any mechanical treatment is taken.

Reduction in fuel loading by hand thinning or mechanical treatment would have a beneficial effect on red-legged frogs by reducing fuel loads and the threat of catastrophic fire. This treatment, however, would be used in very small areas of potential red-legged frog habitat near buildings for defensive space, otherwise all breeding habitat of red-legged frogs would not be treated. Mechanical treatments by inadvertently killing a red-legged frog could be adverse, but would be short-term, and negligible.

Central California Coast Coho Salmon (Oncorhynchus kisutch) – Threatened and Central California Steelhead (Oncorhynchus mykiss) - Threatened

Central California coast coho salmon and Central California steelhead (hereafter referred to as coho and steelhead) occur in several creeks on the Point Reyes peninsula and in the Lagunitas Creek watershed that drains portions of PRNS and GGNRA. The Bolinas Ridge FMU is located within the Lagunitas Creek, Olema Creek, and Pine Gulch Creek watersheds. The Highway One FMU is located within the Olema, Pine Gulch, and Bolinas Drainage watersheds. The Estero FMU is located within the Drakes Estero watershed and the Limantour Road FMU includes the Drakes Estero, Drakes Bay, and Tomales Bay Watersheds (see Figure 16). Lagunitas Creek watershed is part of the Highway One, Bolinas Ridge, and Wilderness South FMUs. Designated critical habitat for coho in PRNS includes all accessible estuarine and stream areas in the coastal watersheds of Marin County except areas above longstanding, naturally impassable barriers or above Peters Dam on the mainstem of Lagunitas Creek and Seeger Dam on Nicasio Creek (NMFS, 2000). Although critical habitat has not been established for central California steelhead, it is likely to be the same as that for coho in Marin County.

For most drainages presence/absence salmonid surveys have been conducted, while in watersheds supporting coho salmon, abundance data on both species is available. The variable life cycle of steelhead makes population analysis more difficult, but also makes them more resilient to adverse environmental conditions. In general, if the habitat requirements for coho were met, steelhead habitat requirements would also be met.

Tomales Bay Watershed

The Tomales Bay watershed includes all of the small watersheds draining from Inverness Ridge and Bolinas Ridge directly to the Bay. The largest of these watersheds, Bear Valley Creek, is included within the Limantour Road FMU. In 1999, the CSRP conducted a smolt trap survey of Bear Valley Creek confirming the presence of steelhead trout.

Under Alternative A, the Limantour Road FMU would be subject to mechanical treatment and prescribed fire. This FMU represents 3% of the total watershed area (see Table 41).

Lagunitas Creek Watershed

Lagunitas Creek has long supported populations of coho salmon and steelhead trout. Recent monitoring efforts within Lagunitas Creek have identified the presence of Chinook salmon for the past four years (MMWD, 2003) with less frequent occurrences of chum and even pink salmon. Lagunitas Creek, and its tributaries, including Olema Creek, Devil's Gulch, and San Geronimo Creek support 10% of the remaining wild coho population within the central California coast ESU (Brown et al., 1994, NOAA Fisheries, 1996).

Reliable quantitative survey data for coho salmon dates from 1948, when the California Department of Fish and Game (CDFG) began annual surveys of coho numbers and spawning activity on Devil's Gulch, a tributary of Lagunitas Creek. Despite the potentially tenuous nature of spawning survey data and inconsistencies in data collection, review of historical spawner abundance data supports anecdotal evidence of declining numbers of coho over the last 50 years.

Devil's Gulch, the only drainage for which long-term data are available, has experienced a sharp decline in numbers (specifically of the PLD Index, in which the highest count of living fish found in a single survey is added to the cumulative number of dead fish counted up to that time) since 1948. More recently, data for both the PL Index and the number of redds (fish "nests" dug in gravel) over the entire Lagunitas watershed indicate an increase. Total numbers of spawning coho using the drainage are suggested by PLD Index value high counts of 525 fish in 1996/97 (see Table 27).

Under Alternative A, the Bolinas Ridge FMU would be subject to prescribed fire. This FMU represents 3% of the total watershed area (see Table 41).

Like Lagunitas Creek, Olema and its tributaries support both coho salmon and steelhead trout. The perennial section of Olema Creek has been systematically surveyed for live adult coho, carcasses, and redds since the winter of 1994/95 (Table 30). Cumulative monitoring results within the Olema Creek watershed, including the mainstem and John West Fork (see Table 31), show considerable variability from year to year and within the cohort years. As in other creeks in the Lagunitas drainage, Olema Creek had a high count for coho salmon in the winter of 1996-97, with a PLD Index value of 174 and the lowest count three years later with a PLD index value of 27. This variability encompasses the range observed within the watershed since 1994/95. In recent years, the coho PLD index numbers have shown a rebound with a PLD index value of 161 fish and 134 redds in 2000/01 and 110 fish and 84 redds in 2001/02.

Under Alternative A, the Bolinas Ridge FMU would be subject to prescribed fire while the Highway One FMU would receive both prescribed fire and mechanical treatment within the Olema Creek watershed. These FMUs encompass 20% of the total watershed area (see Table 41).

Drakes Bay Drainages

The Drakes Bay watersheds include all those draining directly to the Bay from Double Point, north and west to Chimney Rock, with the exception of the watersheds within Drakes Estero (described as separate watershed unit). Watersheds south of Drakes Estero support steelhead trout. While no quantitative surveys have been conducted in the watershed, presence/absence surveys have confirmed steelhead trout to the watersheds south of Drakes Estero.

Under Alternative A, the Limantour Road FMU would be subject to mechanical treatment and prescribed fire. This FMU represents 6% of the total watershed area (see Table 41).

Drakes Estero Watershed

Watersheds draining to Drakes Estero including East and North Schooner, Glenbrook, Muddy Hollow, Home Ranch, and Laguna Creeks support steelhead trout.

Under Alternative A, the Estero and Limantour Road FMUs would be subject to mechanical treatment and prescribed fire. These FMUs represent 23% of the total watershed area (see Table 41).

Bolinas Drainages

The Bolinas drainages including Lewis Gulch and Arroyo Hondo support perennial stream flow and steelhead trout.

Under Alternative A, the Bolinas Ridge FMU would be subject to prescribed fire while the Highway One FMU would receive both prescribed fire and mechanical treatment within the Bolinas Drainages. These FMUs represent 10% of the total watershed area (see Table 41).

Pine Gulch Creek

Pine Gulch Creek supports a population of steelhead and it is generally accepted that it supported a native self-sustaining population of coho salmon into the 1970s. Following thirty years without documented coho sightings, recent NPS monitoring activities have detected the presence of three consecutive cohort year classes in Pine Gulch Creek. Beginning in winter 2000-2001, coho salmon spawners have been observed in low numbers (<5 per year) within the watershed. Modified Hankin-Reeves surveys yielded estimates of 589 (± 329) juvenile coho salmon in September 2001 and 1205 (± 337) juvenile coho salmon in September 2002. The 2002 survey results indicate higher abundance and wider distribution of coho than the 2001 survey. In response to juvenile presence in 2001, a smolt trap was operated in the spring of 2002 capturing 249 coho smolts (Ketcham & Brown, 2003). Evaluation of genetic samples indicate that coho salmon captured during summer 2001 in Pine Gulch Creek have a strong genetic affinity to coho in the Redwood Creek watershed, Marin County (Garza personal communication), six miles to the south.

Under Alternative A, the Bolinas Ridge FMU would be subject to prescribed fire while the Highway One FMU would receive both prescribed fire and mechanical treatment within the Pine Gulch Creek watershed. These FMUs represent 23% of the total watershed area (see Table 41).

35% of the Highway One FMU is within the Pine Gulch Creek watershed.

Analysis

Under Alternative A, the treatments proposed could affect coho salmon and steelhead trout because all four FMUs to be treated have one or both species of fish. Highway One FMU has the greatest potential for possible impacts because of its proximity to Olema Creek and Pine Gulch Creek. The FMU surrounds the road corridor and includes more than 8 kilometers of mainstem habitat supporting coho salmon and steelhead trout.

Prescribed Fire

Fire can modify the quantity, quality, and use of salmonid habitat by altering riparian cover, water temperatures, sedimentation rates, nutrient availability food resources, and woody debris in streams. Because the small to medium sized streams that provide habitat to coho salmon and Central California coast steelhead have narrow valley floors, steep hillsides, and abundant rainfall, they are particularly sensitive to the effects fire can have of removing vegetation and increasing erosion. Riparian zones and fish populations can be influenced by fire and fire management activities occurring upslope as well as along the stream, although a 100 foot buffer between any prescribing burning or mechanical treatment is maintained.

Water temperature is a major factor affecting fish survival, distribution, and production, and can lead to alterations in the timing of critical life history events such as emergence of fry from spawning beds and smolt migration, or to changes in fish species composition in streams. These indirect, longer lasting impacts on water temperature can significantly affect fish populations. Research indicates streamside vegetation can play an important role in maintaining water temperatures. Evidence shows that when streams are protected from fires by a buffer strip of vegetation there is no increase in water temperature during burning (McMahon and deCalesta, 1990). As noted in Alternatives, park scientists would review any given burn plan and determine whether riparian vegetation along streams in the area may need to be retained during a prescribed burn. It is likely this mitigation measure would be added if coho or steelhead are present, preventing more than minor impacts from water temperature changes.

High levels of fuel loading in some areas of the park may create hot spots, or prescribed fires that burn at higher than natural intensities. This would decrease over time as more and more acreage is cumulatively treated, but could cause increased run-off and nutrient loads, even when fire prescriptions are designed to minimize high-intensity fires.

Many studies have assessed the effects of fine sediment on salmonid populations. Direct effects of suspended sediments on fish begin to be observed between 50 and 100 milligrams per liter. (Herbert and Merkens, 1961; Newcombe and MacDonald, 1991; Newcome and Jensen, 1996). Chronic exposures to concentrations greater than 100 milligrams per liter impaired feeding and caused reductions in growth rates, avoidance, and downstream displacement. Adult anadromous fish may avoid concentrations greater than 350 milligrams per liter, impeding upstream migrations (Brannon et al., 1981, Whitman et al., 1982). Stress, as measured by changes in blood chemistry, was reported in fish exposed for short periods to sediment concentrations as low as 50 milligrams per liter (McLeay, et al., 1983). Despite these indications of adverse effects, salmonids thrive in turbid rivers of the northwest, and are able to both live and reproduce in them, even when sediment concentrations are quite high. For example, steelhead were able to spawn in the North Fork of the Toutle River in August 1980, only three months after the eruption of Mount Saint Helens in Washington.

As noted above, PRNS always includes a minimum 100 foot buffer between any prescribed burns and riparian areas. Despite this mitigation measure, prescribed burning could result in increased turbidities in some streams or creeks in the park. Vegetation in the burned areas would return quickly and sediment loss would slow over time. In addition, if upon review of a particular burn plan by park specialists, turbidity increases for coho or steelhead is considered a possible moderate or major adverse impact of prescribed burning, the burn may be cancelled or a series of mitigation measures put in place to bring sediment levels down.

To assure that anadromous salmonid species are protected, Mitigation Measure S-1 would be implemented. This mitigation measure requires that burn plans prepared by the NPS and be reviewed by a subject matter expert such as a hydrologist, erosion specialist, or fisheries biologist to assure that associated erosion control plans and riparian protection corridors are adequate to protect sensitive habitat and resources, prior to approval for implementation. The subject matter expert would determine whether the erosion control plan and riparian protection corridors are sufficient to prevent long-term moderate or major impacts to salmonid habitat. In other words, the expert would determine whether the proposed erosion control strategy would be sufficient to ensure no greater than minor impacts to salmonid from erosion or impacts to the riparian corridor. If the assessment finds that standard setbacks would be insufficient to avoid a long-term moderate or major effect on the salmonid habitat, wider buffers or staggered burning regimes would be implemented. Some of the strategies used to minimize impacts to soils are to avoid steep slopes, time burns to maximize favorable environmental conditions, and erosion control devices during burns.

Coho salmon and steelhead trout appear to be stable under the current PRNS management, including fire management actions that have been conducted over the past several years and would be continued under Alternative A. Prescribed fire, because it is used to restore the natural vegetation structure of park habitats and reduce the risk of catastrophic fire, would have a long-term benefit by protecting dense riparian habitat, keeping water temperature in appropriate ranges, and controlling sediment loading to the stream for these two species. This benefit would be limited by the relatively small area that would be burned annually (500 acres) under Alternative A.

Unplanned Ignitions, Wildfire, and Suppression

As noted above, fire can modify the quantity, quality, and use of salmonid habitat by altering water temperatures, sedimentation rates, riparian vegetation, nutrient availability, food resources, and woody debris in streams. Also, the small to medium sized streams that provide habitat to coho salmon and Central California coast steelhead in the study area are particularly vulnerable to the effects of fire because they are located in steep confined valleys. Whereas prescribed burning is controllable, and can therefore be planned to avoid burning riparian vegetation, unplanned ignitions cannot. In addition, since unplanned ignitions can start anywhere, wildfires can burn hotter when they start. Suppression activities, including line construction, and drops of water or retardant, could also affect water quality or increase erosion temporarily. However, because wildfires in the study area are quite small on average, these adverse effects on coho or steelhead would be no more than minor and short-term. The effects of a larger wildfire are discussed in cumulative impacts.

Mechanical Treatment

Hand thinning and pile burning actions taken to manage prescribed fire would have no-effect or negligible adverse effect on coho and steelhead trout and would not increase sedimentation. The impact is considered negligible because riparian areas and 100 foot buffer strips would not be treated and would reduce or eliminate any sedimentation increase.

California Freshwater Shrimp (Synacaris pacifica)- Endangered
The California freshwater shrimp is found only in sections of a few coastal streams in Marin, Sonoma, and Napa counties. All are low gradient and low elevation streams with undercut banks, exposed roots, woody debris, or overhanging vegetation. They inhabit stream pools one to three feet deep and away from the main current where they hide among willow, blackberry, or other roots (Serpa, 1991). They feed on detritus, including fish that may die as streams dry to isolated pools in the later summer. Existing populations are threatened by introduced fish; deterioration or loss of habitat resulting from water diversion and impoundment; livestock, dairy, and other agricultural activities and developments; flood control activities; gravel mining; timber harvesting; migration barriers; and water pollution. In the study area, the shrimp is found in a portion of the main stem of Lagunitas Creek where it is generally protected from agricultural activities occurring within the watershed. All of Lagunitas Creek occurring in the park is located in the Bolinas Ridge FMU, which would receive treatment from prescribed burning in all alternatives, and from mechanical treatment in Alternative C. Small numbers of shrimp were collected in 1996 and 1997 near the confluence of Olema and Lagunitas creeks (Fong, 1999).

<u>Analysis</u>

<u>Prescribed Fire</u>

The most important features of the environment inhabited by this species in the park are likely to be the continued presence of a structurally diverse stream environment and slower flowing or pooled water. Each of these is dependent on the presence of intact riparian vegetation. As noted above in the discussion of federally listed fish species and red-legged frogs, prescribed burning is generally not conducted in riparian vegetation. If a particular prescribed fire in the Bolinas Ridge FMU may affect riparian vegetation along Lagunitas Creek, park staff would make use of mitigation measures or other standard practices to ensure no habitat of the California freshwater shrimp is affected either directly or indirectly. In addition, prescribed fire, because it is used to restore the natural vegetation structure of park habitats and reduce the risk and possible extent of catastrophic fire, could offer long-term benefits for shrimp. Because the benefit to shrimp would be localized to sections of the Lagunitas Creek and would cover a small area, they would be negligible. These benefits could be short- or long-term, depending on whether the treated areas return to natural fire intervals quickly or need additional treatment.

<u>Unplanned Ignitions, Wildfire and Suppression</u>

As noted in other sections, although the type of impacts from wildland fire and prescribed burning can be similar, their location and intensity can be quite different. The chance of an unplanned ignition burning riparian vegetation on the Lagunitas Creek is higher than prescribed burning and so impacts from changes in vegetation cover or stream flow characteristics are also higher. However, since so few acres burn from wildfire in the study area in an average year, it is both unlikely that riparian vegetation in the habitat area of the shrimp would be affected, and that the impact would be more than negligible if a fire did burn some of this vegetation. The same is true for suppression activities, which could have adverse effects from increases in erosion from line construction, or changes in water quality from retardant drops. Again, because of the small size of most wildfires, the expected impact to shrimp habitat would be non-existent or negligible and short-term.

Mechanical Treatment

No mechanical treatment of Bolinas Ridge FMU is planned for this alternative. Therefore, no impact to California freshwater shrimp is anticipated.

Myrtle's Silverspot Butterfly (Speyeria zerene myrtleae) – Endangered
Myrtle's silverspot butterflies inhabit coastal dune, coastal prairie, and coastal scrub habitats in the study area. It is believed to be extinct everywhere except inside and nearby PRNS. Reasons for its extinction include urban and agricultural development, invasive non-native plants, livestock grazing, over collecting, and other human impacts. Also, although the species uses several plants in the area to obtain nectar, it has only been known to use one, western dog violet (*Viola adunca*), to feed its larvae. The patchy nature of this plant in the area may also have contributed to the rarity of silverspot butterflies.

Three populations are known in the area. One is near the Estero de San Antonio, a second is centered on North Beach, but extends from Abbott's Lagoon to South Beach and east to Drakes Estero and Drakes Beach, and the third is on the Tule Elk Reserve. The highest numbers have been found along the dune-scrub interface in the back dune area of the central peninsula on F and G ranches and the AT&T property, and on the bluffs on either side of the Drakes Beach visitor center. All known populations inside the park are located in the Minimum Management Unit of the park, and would not be affected by prescribed fire or mechanical treatment.

Silverspot numbers in the area outside of park lands around the Estero de San Antonio were estimated at 2,000-5,000 individuals in 1991. Other nearby areas with potentially suitable habitat were not surveyed. Together with those found at Point Reyes, estimated numbers for the three known populations of the species total less than 10,000 individuals (USFWS, 1998). Due to the lack of historic data previous to the 1990s, it is not known if the silverspot has declined at Point Reyes. While surveys of the two populations during the period 1993-1997 found that the Tule Elk Reserve population remained stable and the central Point Reyes population declined sharply, such variation is well within that normally found in Speyeria species (USFWS, 1998).

Analysis

While it is difficult to determine the status of Myrtle's silverspot population at PRNS given current information, the species does not appear to be at risk of extinction in the near future (Launer et al., 1992). In addition, the PRNS does not know if the population is stable, increasing, or declining because of lack of historical data.

Cattle grazing has been identified as only one of a number of possible reasons for the species decline, but is also considered valuable in maintaining Myrtle's silverspot habitat. While several areas have been identified where grazing may be adversely affecting the species' habitat at PRNS, overall grazing management has helped maintain a variety of plant cover conditions in Myrtle's silverspot habitats.

Under Alternative A, all of the occurrences of Myrtle's silverspot are within the Minimum Management Fire Management Unit, and would not be subject to either prescribed burning or mechanical fuels treatments. The populations could be subject to impacts associated with an unplanned wildfire or by fire suppression activities, but this is unlikely because the populations occur within pastures routinely grazed by cattle where fire is unlikely to carry.

Western snowy plover (Charadrius alexandrinus nivosus) – Threatened
Western snowy plovers use the Point Reyes peninsula as both wintering and nesting habitat. Wintering birds occur around Drake's Estero and Abbott's Lagoon, and along Limantour Spit and the Great Beach. Nesting is occurring on the northern portion of Great Beach and along the western edge of Abbott's Lagoon.

Monitoring of nesting snowy plovers in 1986-1989 and 1995-2002 indicated a decline in the number of nesting birds through 1996, followed by a gradual rebound. This rebound is at least in part due to a program initiated in 1996 to increase nesting success. The program includes the use of signs, closures to dogs and/or human visitors, exclosures over nests and the use of docents to monitor visitor use and increase visitor education. The current nest protection program has raised nest success rates to levels similar to those at other coastal California locations.

Analysis

All of the occurrences of western snowy plovers are within the Minimum Management Fire Management Unit, and would not be subject to either prescribed burning or mechanical fuel treatments. The populations could be subject to impacts associated with an unplanned wildfire or by fire suppression activities, but this is unlikely because the plovers occur in beach areas where fire is unlikely to carry.

Ravens are the primary predator on eggs and small chicks of plovers. Ravens and crows may be attracted to fires because potential prey are exposed and concentrated around fires. Fires may indirectly affect plovers if ravens concentrate in burned areas adjacent to plover nesting habitat and if raven populations are enhanced by a boost in prey available during a fire.

Additional Wildlife Species of Management Concern

This section analyzes impacts to wildlife that are not federally listed, but may be affected by fire management activities. Because Point Reyes Mountain Beaver is most likely to experience impacts, it is treated separately.

Point Reyes Mountain Beaver (Aplondontia rufa phaea)
The Point Reyes mountain beaver, a muskrat-sized rodent found only in scrub habitat in western Marin and almost entirely in Point Reyes National Seashore, is listed as a Species of Concern by the US Fish and Wildlife Service and the California Department of Fish and Game. Two small, geographically isolated populations of mountain beaver live along the California coast, both of which are distinct subspecies. The Point Arena mountain beaver (*A. r. phaea*) is federally listed as Endangered. Its entire range encompasses approximately 60 km^2. Mountain beaver may be

adversely affected by actions described in the Fire Management Plan alternatives, but most particularly by large-scale unplanned ignitions.

Analysis

Prescribed Fire

The mountain beaver was severely affected by the 1995 Vision wildfire in Point Reyes, presumably through direct destruction and dehydration, as roots and vegetation from which is obtains water was destroyed on over 12,000 acres. This species is known to require up to two cups of water per day to survive. However, prescribed fires in this alternative and all alternatives in this EIS would not burn large areas of brush, or burn with the kind of high intensity characteristic of the Vision wildfire. Mountain beaver would be able to outrun or avoid a prescribed burn over most of its habitat, and would be able to survive on neighboring plants until its habitat is revegetated. Revegetation would occur quickly, as prescribed burns are timed to fall before the rainy season in most cases. Ultimately, the kind of succulent plant material mountain beavers require would be more abundant as a result of controlled burning over the up to 500 acres allowable under Alternative A. Mountain beaver are known to occur in Estero and Limantour FMUs, slated for prescribed burning in this alternative, and so a negligible to minor long-term benefit from using prescribed fire to reduce the risk and extent of a large-scale wildfire is likely.

Unplanned Ignitions, Wildfire and Suppression

Studies conducted before and following the 1995 Vision Fire in Point Reyes revealed that Point Reyes mountain beaver suffered high mortality. Pre-fire estimates indicated about 5,000 individuals in the area ultimately burned. Following the fire, only 19 live mountain beavers, or less than 1% of the pre-fire population, were located over this same area (Fellers et al., 2003). Major vegetation changes occurred in parts of the beavers' habitat, including a reduction in coastal scrub and coyote brush. Monitoring in the years following the fire indicate that recovery of the populations has been slow (Fellers, 2003).

Fellers (2003) recommended that fires in the vicinity Point Reyes mountain beaver not be allowed to burn substantial portions of areas occupied by mountain beaver. Periodic small fires, such as prescribed burns or wildfires in an average year at the park, would allow for normal changes in mountain beaver habitat by mimicking what was probably the natural fire regime with which these animals evolved.

The following mitigation measures would be implemented:

- identify and map areas known to support Point Reyes mountain beaver and areas that have habitat suitable for supporting Point Reyes mountain beaver,
- protect known and potential habitat from unplanned ignitions,
- establish buffer areas 30 feet wide around known habitat areas, and
- conduct small burns (less than 100 acres) of mountain beaver habitat each year.

Implementing these mitigation measures would keep impacts of average wildfires in the study area to no more than minor and short-term.

Mechanical Treatment

The presence of humans thinning brush or conducting other activities such as chipping could disturb mountain beavers, but the impacts would be minor and temporary. Mechanical treatment would help to remove fuels and reduce the risk of another catastrophic wildfire in the park. Because mechanical treatment would be limited in scope in this alternative, this beneficial impact would also be no more than a minor one, although over several years the reduction in risk could be a larger and more permanent one.

Other Special Status Wildlife

Analysis

Table 33 in Affected Environment lists several animal species in the project area that are listed as federal Species of Concern. Species of Concern are those for which USFWS is collecting additional information to determine if they warrant consideration for future listing. The animal Species of Concern lists 9 mammals, 23 birds, 3 reptiles, 2 amphibians, 3 fish, and 10 invertebrates. The table also shows which species are potentially subject to adverse effects.

Prescribed Fire

The effects of fire on the animal species listed in Table 33 are not fully known. However, the park's mean surface fire intervals of 7 to 13 years (Brown et al., 1999) indicate fire is an integral part of the natural ecosystem at Point Reyes. Fire research has demonstrated that fire plays a critical role in the management of many species of concern with regular burn intervals. For example, fire helps maintain open areas, creates a diversity of habitats, can create food sources, and in some cases, removes non-native competitors. Even though individuals of some Species of Concern may be killed by prescribed fire, the removal of competitors has a long-term beneficial effect as fire dependent native species will return, while the non-native competitors often will not (National Biological Service, 1995).

Regarding effects on mammal species of concern, Ream (1981) summarized information in 237 references about effects of fire on fauna. She concluded that populations of ground squirrels, pocket gophers, and deer mice generally increase after stand-replacing fire. On the other hand, Wirtz (1977) found that populations of brush mouse, western harvest mouse, and woodrat species decrease or disappeared in burned chaparral and grasslands. At Point Reyes, the mammals of concern are primarily bat species. Based on the limited number of acres to be burned and the ability o f bats to leave an area, minor short-term impacts could be both beneficial (creates food sources) and adverse (some mortality may occur in roosting sites).

The species of concern Table 33 includes 23 species with only eight species that have the potential to be affected. The olive-side flycatcher and Pacific-slope flycatcher could be beneficially affected because studies have shown flycatchers (Wirtz, 1977) increased the first year after a burn. White-tailed kites could be beneficially affected because raptors in general are unaffected or respond favorably to burned habitat (Smith, 2000). It is not known how other species of birds Allen hummingbird, short-eared owl, tricolored blackbird will respond to fire; however, because of the limited number of acres burned each year, the effects on populations of these species would be minor.

Amphibians and reptiles Species on Concern on the USFWS list should not subject to adverse effect because most do not occur in the project area. Only one species, the northwest pond turtle, is known to occur and it major habitat - ponds - would not be subjected to burn treatments.

No fish Species of Concern would be impacted by prescribed fire.

There are ten invertebrate Species of Concern. The potential to impact these species is primarily unknown. However, soil protects most soil macrofauna and pupae of many insects from fire. In addition, a study by Evans (1971) indicates 40 species of arthropods are attracted to fire and many uses burned trees for breeding and food.

To sum, based on the above and because prescribed fire would be limited in scope and would not involve a large component of the habitat of any population of animal Species of Concern, impacts to animal Species of Concern would be limited. This means both the potential for adverse or beneficial impacts would be no more than minor. Adverse impacts would be short-term for the most part, but beneficial impacts could be long-term.

Unplanned Ignitions, Wildfire, and Suppression

The average acreage burned by wildfire in the study area is less than 30 acres; because it is small in scope, the chance of wildfire or suppression in an average year having more than a negligible or minor adverse impact to other special status wildlife is low. Impacts may be short- or long-term depending on the intensity of the fire or location and extent of suppression activities.

<u>Mechanical Treatments</u>

Mechanical thinning activities such as mowing are not expected to have any long-term adverse impacts on the other special status species on Table 33.

Regarding effects on mammal Species of Concern, at Point Reyes, the mammals of concern are primarily bat species. Based on the limited number of acres to be mechanically treated and the ability of bats to leave an area, minor short-term impacts could be both beneficial (creates food sources) or diverse (some food sources many be lost).

The bird Species of Concern table includes 22 species with only eight species that have the potential to be affected. However, because of the limited number of acres to be mechanically treated each year and mowing would be done after the nesting season, the effects on populations of these species would be short-term and minor. There may be long-term beneficial effects because of the maintenance and creation of a mosaic of habitats.

Amphibians and reptiles species on concern on the USFWS list should not subject to adverse effect because most do not occur in the project area. Only one species, the northwest pond turtle, is known to occur and it major habitat - ponds - would not be subjected to mechanical treatments.

No fish Species of Concern would be impacted by mechanical treatments.

There are ten invertebrate Species of Concern. The potential to impact these species is primarily unknown. However, because soil disturbance would be minimal and the total number of acres to be treated is small, impacts would be short-term and negligible to minor.

To sum, based on the above and because mechanical treatments would be limited in scope (compared to total park acres) and would not involve a large component of the habitat of any population of animal Species of Concern, impacts to animal Species of Concern would be limited. This means both the potential for adverse or beneficial impacts would be no more than minor. Adverse impacts would be short-term for the most part, but beneficial impacts could be long-term.

Effects of Fire Information/Education on Special Status Wildlife

Impacts associated with fire information and education would largely be indirect and beneficial, although they would be highly dependent on the nature of the fire management action on special status species. Pre-planned events such as prescribed fires and mechanical treatment provide the opportunity to demonstrate the effectiveness of natural resource management to local communities and the interested public. During unplanned events, such as wildfires, time for effective communication is often more limited and can be more controversial since resources are often damaged. However, education does not usually have a direct effect - positive or negative - on impacts to special status species. In some cases, education can be used to enforce a closure of an area to ensure a special status species is protected or to ensure voluntary compliance for actions that would help ensure the survival of the special status species.

Effects of Fire Cache/Park Headquarters Relocation and Construction on Special Status Wildlife

No adverse or beneficial indirect effects are anticipated with the construction of the new fire cache. The building site is a former trailer pad that was recently removed in the main developed area of the park at Bear Valley and has already been heavily impacted. The area has been surveyed and has no special status species in the construction footprint.

Fire Effects and Fuel Management Research

No adverse or beneficial direct effects are anticipated on wildlife from the implementation of Alternative A research projects. There are indirect beneficial effects for conducting research that would help identify future management prescriptions for special status species protection.

Cumulative Impacts of Alternative A to special status plant and animal species

This section describes impacts from sources other than the fire management plan that have or are adversely affecting the special status species analyzed above, or that may adversely affect them over the life of this plan. The known sources of impact are human development and human activities both inside and outside the park, construction activities listed in Appendix C, and a large-scale wildfire in the region.

Perhaps the largest threat to these species from park activities is the risk of a large-scale fire similar to the 1995 Vision Fire. The effects of such a fire would be intensified by the fuel buildup in the park associated with a policy of fire suppression over the last 150 years. As did the Vision Fire, another very large and hot fire could create a multitude of habitat changes and serious impacts for park wildlife, including extensive forest gaps, discontinuous habitat, and greater consumption of large woody debris than what would be expected under natural fire conditions. High-severity fires in Point Reyes are characterized by extensive burned areas that may be continuous from ridgeline to slope bottom and include riparian areas, eliminating habitat for several of the species identified above, such as red-legged frogs, coho, steelhead and California freshwater shrimp. In addition, there would be a type conversion of habitat in some areas - forest to brush/grassland and some long-term loss of forest habitat. This change in habitat could have short-term major adverse impacts or long-term moderate impacts to species status species in the burned area. For example, the Vision Fire had a major adverse effect on mountain beaver, and the population is only slowing recovering (Fellers, 2003).

A secondary widespread and serious consequence of catastrophic fire is the increase in erosion and turbidity that follows the loss of vegetation. Sediment loads following a wildland fire similar to the Vision Fire would be expected to be at least twice the normal load under natural conditions (Ketcham, 2003). The sediment loads and lack of riparian vegetation would have adverse, moderate, long-term impacts (more than two years) to special status fish and aquatic species such as coho salmon, steelhead trout, and red-legged frogs. However, vegetation would return in the long run, as it has following the 12,000+ acre Vision Fire, and rates of erosion would return to rates within the natural rate of variability, preventing long-term impairment of park resources.

Species specific cumulative impacts from both large-scale fire and other relevant sources are described below:

Northern Spotted Owl. Cumulative impacts to spotted owls come from development, visitor use, habitat changes, and can come from large-scale fire.

Visitor use in the park is expected to increase along with the projected human population increase in the San Francisco Bay Area. With increased visitor use of the park, the potential for human disturbance of owls along trails may increase. To reduce visitor impacts to owls, the park does not publish the location of owl activity centers and distributes a flyer on how to behave around owls.

Oaks in Marin and Sonoma counties have been dying suddenly over the past few years as a result of a fungus. The die-off, called Sudden Oak Death (SOD), has spread throughout Marin county and is currently in some owl habitat in the park. The death of the oaks results in local changes in percent cover and in food availability of the dusky footed woodrat, the primary prey of owls, at PRNS (Chow and Allen, 1996). Widespread habitat conversion is not expected from SOD in the study area; however, park biologists are monitoring the distribution of the die-off. Additionally, UC Berkeley (P. Gong, Professor, ESPM, UCB, pers. com.) is mapping the spread of the disease throughout Marin County.

An ongoing threat to spotted owls is development, which removes habitat and creates smaller blocks of forest, or forest that is discontinuous. As noted in Affected Environment, smaller isolated tracts of forest that would otherwise be suitable do not meet the needs of spotted owls, which require large contiguous blocks. Of the four categories of land described below, private land without conservation easements or other protection is most vulnerable to development.

<u>Public land protected from development in perpetuity</u>. These include the 2,700 acre Samuel P. Taylor State Park and the 21,250 acres held as watershed and public recreation areas by the Marin Municipal Water District (MMWD). These lands border the Northern District of GGNRA along Nicasio and Bolinas Ridges and provide unbroken habitat connections to an extensive area of central Marin County. The Tomales Bay State Park provides unbroken habitat along the east side of the bay contiguous to GGNRA lands at and near the mouth of Lagunitas Creek.

<u>Privately owned conservation land</u>. Land that has been purchased by non-profit groups for conservation purposes offer long-term habitat protection only slightly less secure than that of publicly held land. The Audubon Canyon Ranch (ACR) includes an inholding on Bolinas Lagoon that connects GGNRA lands adjoining it. Other ACR holdings on Tomales Bay protect undeveloped bay frontage adjoining State Park lands. A second non-profit group, the Vedanta Society, holds a 2,143 acre parcel in the Olema Valley bounded by PRNS and GGNRA lands. Acquisition of this land by the NPS has not been pursued because the Vedanta Society conducts only low impact activities on the property. Acquisition could still take place if management of the land was considered inconsistent with NPS policies.

<u>Private land</u>. In 1971, county supervisors enacted A-60 zoning (one house per 60 acres) for much of western Marin, significantly limiting the development potential of agricultural properties. Such zoning covers extensive areas of private land adjoining public park and watersheds, including San Geronimo Valley, Nicasio Valley, and the northwestern portion of the county. Since that time, zoning for the West Marin Planning Area has been elaborated to include a variety of zoning densities in areas adjacent to established towns, with minimum lot sizes ranging from one unit per acre to one unit per 60 acres.

While these policies provide substantial protection for owl habitats, they could be overturned by the county Board of Supervisors, and so cannot be regarded as permanent protection. At this time, support for low-growth, low-density development policies in Marin County is high and it seems highly unlikely that this will change in the future.

Private land with conservation agreements. Agricultural land in west Marin has been and continues to be at risk of being broken up into the large residential lots permitted by county zoning. To prevent this, a private non-profit land trust, the Marin Agricultural Land Trust (MALT), has been acquiring development rights to agricultural land since 1980. At present, this group holds the rights for over 30,000 acres on 43 ranches in western Marin County. Like other conservation lands held by non-profit groups, the security of protection of these lands depends on the future financial condition of the non-profit, which in the case of MALT appears to be secure.

The impact of a large wildfire on spotted owls would be habitat destruction. As noted in Affected Environment, this species requires greater than 60% total canopy cover for nesting/roosting with large overstory trees, large amounts of down woody debris and the presence of trees with defects or signs of decadence in the stand. This old growth type forest in the park may have the high fuel loading and ladder fuels to feed a hot stand-replacing fire, which would eliminate the habitat for many years. In a large wildfire, such as the Vision Fire, the chances of directly destroying nests or habitat could be quite high. Suppression activities such as water and retardant drops would have an adverse effect on spotted owls if they occurred over nesting habitat and, especially, nests. Such events are less likely than direct destruction of nests or habitat to occur, and impacts would be mitigated if nest sites and probable nesting habitat could be avoided. Helispots and spike camps would potentially have an adverse effect on spotted owls if they were located close to nesting or roosting areas and the level of disturbance were high. Hand-line for suppression, if constructed through a spotted owl nesting or roosting area, would potentially cause adverse effects from disturbance and habitat alteration, especially if trees were felled. Snags are often used by spotted owls as nest sites. As such, snagging operations to protect human safety and the integrity of fire lines would potentially have an adverse effect on spotted owls.

Red-legged Frogs. As described above, lands outside of PRNS and GGNRA offer substantial protection for wildlife through conservation easements, zoning, and low-impact land use practices. Extensive areas adjoining the study area preserve continuous habitat and much of that land is occupied by the red-legged frog. These parcels include nearly 25,000 acres of public land, thousand of acres of conservation land privately held by non-profit groups, and over 30,000 acres of private land with conservation easements preventing development. In addition, much of western Marin is zoned at a very low density, particularly where it adjoins watersheds where red-legged frog habitat exists.

Additional impacts to frogs may come from actions listed in Appendix C, including some restoration projects such as of the Giacomini wetlands or of fisheries in streams where frogs are known to occur. Impacts would be avoided, minimized, or mitigated however, and all project sites would be reviewed prior to implementation with the park GIS database. If there was potential for a take, the park would have staff specialists survey the site and provide recommendations for avoidance or mitigation. In the long-term, these fisheries restoration projects would benefit frogs by enhancing natural processes, including reduction of erosion and stream temperature and enhanced water quality.

Human activities may have had both direct and indirect effects on red-legged frogs. Development has removed habitat, and logging or other activities may have adversely affected geomorphological stability, erosion rates or river channels. For example, historic logging of parts of Inverness Ridge, channel alterations in the lower 2.8 km of Olema Creek, and the effects of highway culverting have removed suitable habitat along Olema Creek and its tributaries may have been. Areas of downcutting, bank cutting, and sedimentation are present along the mainstem and its tributaries, resulting in a probable reduction in numbers of backwaters and pools.

Ranching may also have adversely affected frog habitat, although since coming under NPS ownership and oversight, ranching practices on PRNS ranchland have been modified in ways that have likely benefited California red-legged frogs. Especially effective have been the reductions of cattle numbers on excessively grazed ranchlands and exclusion of cattle from a number of wetland sites. The species appears to be thriving under the current PRNS management of grazing lands, although cattle may be having adverse impacts in some locations. Current information supports the conclusion that grazing may both benefit and harm red-legged frogs, and that more research on optimal habitat conditions for the species is needed. Because cessation of grazing may be more deleterious to the species than its continuation, however, ranching permits would be renewed. Efforts to identify and protect potentially vulnerable habitats and to develop research that would improve knowledge of the best habitat conditions for the species, as described in the Draft Recovery Plan (USFWS, 2000), would be undertaken.

As noted above, fire can adversely affect frogs by removing riparian vegetation, and through the increase in sedimentation accompanying vegetation removal. Both of these effects would be more likely and more severe in a large-scale wildland fire than under a regime of prescribed burning or average wildland fire conditions.

PRNS is currently conducting a wetland mapping and assessment project within the public lands of the Tomales Bay watershed, including Olema Creek, Lagunitas Creek, and Tomales Bay FMP watersheds. The purpose of this project is to map wetlands and to conduct functional assessments of the wetland features within the watershed. Wetlands were previously documented using National Wetlands Inventory (NWI) procedures, which produced incomplete wetland mapping for PRNS and some areas of GGNRA. Only larger, more visible wetland types were mapped, while many of the variety of wetland types found at Point Reyes were missed. When completed, this work would provide data needed for future wetland protection, restoration, and planning. Such protection would likely benefit red-legged frogs and water quality within the project area.

Dating back to the late 1800s, West Marin County was a popular destination for salmon fishing. Records of salmon hatchery releases to Lagunitas Creek and even Bear Valley Creek occurred even in the 1890s. Lagunitas Creek (then known as Papermill Creek) still holds the distinction as having produced the state record, 22 pound, coho salmon (caught by Milton T. Hain, January 3, 1959). Interviews with long time residents and fisheries managers suggest that coho and steelhead in the project area have been declining since the turn of the century, with significant declines occurring as late as the mid-1950's. Most historic information on salmonid numbers is anecdotal, while quantified data are lacking. Accounts by local residents of "excellent trout fishing" along Lagunitas and Olema creeks may refer to young steelhead, which are indistinguishable from rainbow trout during the three year period they typically spend in fresh water. Similarly, early accounts of "salmon runs" may refer to both coho and steelhead, which may not have been distinguished by fishermen. Such anecdotal information suggests that salmonids were abundant in the Lagunitas/Olema Creek drainage before extensive alteration by dam-construction, logging, and channelization. On its 1996 federal listing, the Lagunitas watershed, including Olema Creek, was documented to support 10% of the Central California Coast coho population (Brown et al., 1994; NOAA Fisheries, 1996).

The mouth of Lagunitas Creek and adjacent floodplain supports activities associated with the Waldo Giacomini dairy. This 563-acre property, once tidal wetlands, was diked and drained in the early 1940s to create pastures. For many years, a gravel dam was constructed annually just below the confluence of Lagunitas and Olema creeks for irrigation and stock watering. The dam created an abrupt transition from fresh to saline water for smolts and spawning adults, eliminating the transition zone found in an unimpaired estuarine system. The transition zone allows smolting fish time to adjust to saline conditions and provides productive feeding zones where both freshwater and saltwater invertebrates are available (SWRCB, 1995).

The dam and the levees concentrated the area where spawning fish could hold and smolts could feed, and increased the potential for predation. While the annual construction of the dam has been discontinued, the levees are still in place. PRNS is currently acquiring these lands and developing a floodplain restoration plan. A phased restoration project requiring from five to ten years is planned to begin after final acquisition in 2007. Such restoration is expected to improve estuarine smolt and adult emigration habitat for both coho and steelhead.

The Coastal Watershed Restoration Project, proposed for nine sites within the Drakes Estero Watershed is planned for construction in 2006. The activities proposed through this project will remove or replace facilities such as road culverts and impoundments that impede natural freshwater and estuarine process. All treatment sites will meet fish passage design guidelines established by the NOAA Fisheries and CDFG (NOAA Fisheries, 2001; CDFG, 2003).

A large-scale wildfire could have moderate impacts on either species by removing riparian vegetation, increasing water temperature and removing upslope vegetation, with resultant increases in erosion and sedimentation. As noted above, the streams in which coho and steelhead exist in the study area are often in narrow, confined valleys with steep, vegetated slopes. A large, hot wildfire in such a valley would be difficult to suppress, and could quickly destroy riparian or slopeside vegetation. Suppression activities could also have short-term moderate effects through retardant drops and resultant changes in water quality.

Western Snowy Plover. Along the California coast, western snowy plovers have been extirpated from 33 of 53 nesting sites since 1970, and now number approximately 1,400 birds (USFWS, 1993). Although it is not one of the eight areas that support 78 percent of the California coastal breeding population, PRNS is 1 of only 20 remaining plover breeding areas in coastal California (USFWS, 1993). The Point Reyes peninsula is one of the largest relatively undisturbed beach habitats on the California coast, providing a large area of potential snowy plover habitat free of threats that have impaired habitat elsewhere, such as development, ORV use, and heavy visitor use.

Fledging rates for snowy plovers before nest protection began were insufficient to maintain the species at PRNS, as indicated by declining numbers of nests and nesting adults in the period 1986-1995. Continuation of such low nest success rates could have resulted in loss of the PRNS breeding population of snowy plover. The current nest protection program has raised nest success rates to levels similar to those at other coastal California locations (USFWS, 1999a), but would be costly to maintain indefinitely.

Myrtle's Silverspot Butterfly. The largest numbers of Myrtle's silverspot butterflies documented in the early 1990s occurred on private land in the vicinity of Estero de San Antonio in Marin County northeast of PRNS. A golf course development proposed at that time was withdrawn, and the area is currently ranchland grazed by cattle and sheep. It is given a measure of protection from development by Marin County's agricultural zoning and policies to maintain the integrity of ranchlands in the western half of the county. Several of the ranches in the habitat area have sold development rights to the MALT, an organization seeking to preserve agricultural land in western Marin County. Any proposed development would have to comply with requirements of the ESA to protect the Myrtle's silverspot.

While it is difficult to determine the status of Myrtle's silverspot population at PRNS given current information, the species does not appear to be at risk of extinction in the near future (Launer et al., 1992; A. Launer, Stanford University, pers. com.). Cattle grazing has been identified as only one of a number of possible reasons for the species decline, but is also considered valuable in maintaining Myrtle's silverspot habitat.

Cattle grazing has been identified as only one of a number of possible reasons for the species decline, but is also considered valuable in maintaining Myrtle's silverspot habitat. While several areas have been identified where grazing may be adversely affecting the species' habitat at PRNS, overall grazing management has helped maintain a variety of plant cover conditions in Myrtle's silverspot habitats.

Conclusion

All known individuals of the seven federally listed as threatened and endangered plant species in the study area occur in the Minimum Management Fire Management Unit, and so would not be subject to either prescribed burning or mechanical fuels treatments. The populations could be subject to impacts associated with an unplanned wildfire or by fire suppression activities, but this is unlikely because the populations occur in wet sites, within pastures routinely grazed by cattle, or on beaches or rocky outcroppings where fire is unlikely to carry.

Plant species that are not federally listed, but are of concern would likely continue to receive minor long-term benefits from prescribed burning and mechanical treatment, and the eventual return of natural fire cycles. Some patches or individuals of these species may experience minor, adverse effects from destruction through fire or suppression, or from the inadvertent stimulation of invasive exotic species from burning.

Prescribed fire and mechanical treatments would offer negligible to minor, long-term benefits on a limited scale to northern spotted owls, red-legged frogs, and California freshwater shrimp (the latter from fire only) by reducing the threat of catastrophic fire and the habitat destruction it would bring. Mechanical treatments such as hand thinning and pile burning to manage prescribed fire would have a minor, short-term, adverse effect on owls through possible human disturbance, reduction of prey species, and habitat alteration in unknown roosting and nesting sites, and on frogs from inadvertently killing individuals. No mechanical treatment is planned in the Bolinas FMU, in which habitat of the freshwater shrimp occurs. Large-scale wildfires could have more serious adverse effects on owls by eliminating habitat, and on frogs by burning riparian vegetation and increasing sedimentation. Both these species experience a positive cumulative impact from the large blocks of conservation land adjacent to the study area.

Adverse impacts to coho salmon and steelhead trout from prescribed burning would be negligible to minor, as riparian vegetation would be retained. Negligible positive benefits from reducing the risk and extent of a catastrophic burn would result from both prescribed burning and mechanical thinning. A large-scale wildfire would have more serious adverse effects by increasing siltation of streams and burning riparian vegetation, which in turn would increase water temperature.

Both Myrtle's silverspot butterfly and snowy plovers occur only in the Minimum Management FMU, and so would not be subject to either prescribed burning or mechanical fuel treatments. The populations could be subject to impacts associated with an unplanned wildfire or by fire suppression activities, but this is unlikely because the populations occur within pastures routinely grazed by cattle (silverspot) or beach areas (plover) where fire is unlikely to carry.

The impacts of fire management activities, including those of average size and intensity wildfires in the study area on Point Reyes mountain beaver would be kept to no more than minor and short-term through the use of mitigation measures. Large-scale wildfires could have moderate adverse impacts that may be long-term.

There would be some indirect long-term benefits by conducting research and fire education. There are no adverse impacts to special status species by the construction of the fire cache.

No impairment to park special status species would occur from implementing Alternative A.

Alternative B

Impacts on Federally Listed Plant Species

Analysis

All of the plants identified above in Alternative A as on the federal list of threatened and endangered species are located primarily in the Minimum Management FMU, which is not treated by prescribed fire or mechanical thinning. These species include the Sonoma spineflower, Robust spineflower, Tiburon paintbrush, Marin dwarf flax, beach layia and Tidestrom's lupine.

Although this FMU may have some small wildfires, on average no more than about 30 acres of the entire study area burns in a given year. Since most of these plants are located in well grazed pastures or rocky outcrops, they are unlikely to be burned by wildfires in the park in average years. The impacts of Alternative B are the same as Alternative A on all of these species, with the exception of Sonoma alopecurus, which does occur in the Palomarin FMU. It is treated separately below.

Sonoma alopecurus (Alopecurus aequalis var. sonomensis) – Endangered
Sonoma alopecurus is a perennial grass that grows in the park primarily on pastures in agricultural areas. It favors moist or wet sandy soils.

Other Special Status Plant Species

Analysis

Under Alternative B, 9 FMUs are treated for a total of up to 2,000 acres per year. Estero, Inverness Ridge, Limantour, Wilderness North, Wilderness South, Highway One, Inverness Ridge, and Palomarin FMUs would be treated with both prescribed fire and mechanical thinning. Tomales Point would only be mechanically treated, and Bolinas Ridge FMU treated only with prescribed fire.

Prescribed Fire

As noted in the analysis in Alternative A, fire is an integral part of the natural ecosystem at Point Reyes and likely plays a critical role in the management of many plant and animal species of concern by maintaining open areas or stimulating reproduction. Prescribed burning may kill some individuals of these species, but it would also remove competitive non-native species and would have a beneficial impact in the long-term because of this. While this benefit would remain minor, it could conceivably be double or more that of Alternative A depending on the location of populations of each species. For example, Alternative B would use prescribed fire to treat areas in Inverness Ridge FMU, Wilderness South, and Palomarin FMUs. All of these FMUs have Marin manzanita, a species considered rare and declining inside the park because it requires fire to flourish. Adverse impacts would also be no more than minor and short-term, but could be more severe or widespread than in Alternative A, again because additional acreage would be burned.

Unplanned Ignitions, Wildfire, and Suppression

No changes in impacts from unplanned ignitions, average annual wildfires or their suppression are expected in this alternative from those described for Alternative A.

Mechanical Treatments

Mechanical treatment is not expected to have any adverse impacts on special status plants as mowing would be done in the fall and rare plants populations would be excluded from treatment areas.

Fire Information/Education

No impact to any plant special status species is expected from the distribution of fire information or education.

Fire Cache/Park Headquarters Relocation, and Construction

Because the area where the fire cache is planned would be surveyed prior to construction, impacts to protected plant species would be minimized. It is possible that individuals would be affected, but the extent of the effect would be minor.

Fire Effects and Fuel Management Research

No specific effects to any special status plant species from fuel management research under Alternative A are expected. However, small controlled burns in Bolinas Ridge and Palomarin FMUs would be conducted to determine post-burn species richness of native plants, and to determine if reducing the density of non-native species is possible using prescribed fire. Two special status plant species occur in these two FMUs. Although the federally endangered Sonoma alopecurus did occur at one time in the Palomarin FMU, this population has been extirpated.

Federally Listed Wildlife

Northern Spotted Owl (Strix occidentalis caurina) - Threatened

Under Alternative B, potential effects on northern spotted owls are greater than Alternative A because additional FMUs are being treated that are considered habitat. Two additional FMUs to be treated, in particular, Wilderness North and South, have considerable spotted owl habitat, and owls nest in the Inverness Ridge FMU as well.

Prescribed Fire

As noted in Alternative A, fuels have built up in spotted owl habitat making catastrophic, stand-replacing fire more likely. Such as fire would destroy spotted owl habitat for many years; prescribed burning is considered an important tool in helping to reduce these unnatural accumulations of fuels and ladder fuels and preserve owl habitat.

Preparatory burns and mechanical fuel reduction would be used to control fire intensity in areas in owl habitat, and no treatment would occur within 400 meters of a nesting or known roosting site. Prescribed fire planning also takes into account other important habitat components, such as down, woody debris that provide habitat for dusky-footed woodrats, which are an important prey species for northern spotted owls in the project area. If a prescribed burn does reduce the amount of woody debris, or would otherwise adversely affect woodrat habitat or nests, it would have an indirect minor, short-term, adverse effect on spotted owls.

Currently, no program elements exist for the management of prescribed fires for the benefit of spotted owls. The use of prescribed fire under Alternative B, would, nonetheless, have a beneficial, long-term, and minor impact on northern spotted owls, primarily through reduction in the threat of catastrophic fire in some areas.

Unplanned Ignitions, Wildfire, and Suppression

No impacts different than those described above for Alternative A would result from unplanned ignitions, wildfires or suppression in Alternative B. To sum, because average annual acreage burned from wildfires at the park is quite low, any more than minor adverse impacts from average annual wildland fires is unlikely.

Mechanical Treatments

Under Alternative B, hand thinning or mechanical treatments in the vicinity of development and roads such as on Bolinas Ridge, Wilderness North, Wilderness South, and Highway One FMUs could have an adverse effect on spotted owls if canopy closure was substantially reduced. This is especially true where developed areas interface with dense forest that provides roosting and nesting habitat. Under Alternative B, cutting large trees would be limited because techniques would be confined to hand thinning and then piling and burning. In some areas, clearing understory vegetation could, in fact, improve foraging conditions for spotted owls and habitat for it prey item - woodrats. Overall, impacts would remain localized and therefore minor.

Chipping over a wider area of the park and in more owl habitat than in Alternative A would be conducted under Alternative B. Chipping cut material and then distributing it over a site could occur where air quality, visitor use, or other management concerns prohibit burning. The equipment used to chip material is extremely loud and, if operated nearby, may disturb spotted owls. Although more chipping would take place in this alternative, impacts to owls would still be localized and temporary, and would therefore be no more than minor.

Fire Information/Education

No impact to spotted owls from the distribution of fire information or education is expected.

Fire Cache/Park Headquarters Relocation, and Construction

The fire cache would not be located in the vicinity of spotted owl activity centers or potential habitat, so no impact is expected.

Fire Effects and Fuel Management Research

No effects to spotted owls from fuel management research under Alternative B are expected.

Red-legged Frog (Rana aurora draytonii) – Threatened

Analysis

Prescribed Fire

Prescribed fire, because it is used to restore the natural vegetation structure of park habitats and reduce the risk of catastrophic fire, would have a long-term benefit to red-legged frogs and their habitat. Although this benefit would remain somewhat limited, it would be greater than Alternative A. In particular, frogs in the Palomarin, Inverness Ridge, Wilderness South, and Wilderness North FMUs would be benefited, as these FMUs are not subject to prescribed fire in alternative A.

High levels of fuel loading in some areas may cause prescribed fires to burn at higher than natural intensities, even when fire prescriptions were designed to minimize high-intensity fires. Higher intensity burns could inadvertently kill individual frogs or dry out pond habitat or vegetation the frogs need to move between ponds. They could also increase sedimentation. However, the extent of these types of impacts under the prescribed burn program proposed in this alternative would be quite small, or perhaps even largely non-existent, and adverse impacts would be negligible. In addition, burn plans in frog habitat would be reviewed and important frog habitat avoided if prescribed fire would be damaging.

Unplanned Ignitions, Wildfire, and Suppression

The same short-term and negligible adverse impacts from small wildfires as described in Alternative A would be possible in this alternative as well.

Mechanical Treatment

Mechanical treatment such as hand thinning, line construction, and pile burning could disturb frogs or alter their habitat. However, impacts would be no more than negligible because breeding areas and adjacent non-breeding areas would be identified and avoided before any mechanical treatment is taken.

Reduction in fuel loading by hand thinning or mechanical treatment would have a negligible, long-term, beneficial effect on red-legged frogs by reducing fuel loads and the threat of catastrophic fire.

Central California Coast Coho Salmon (Oncorhynchus kisutch) – Threatened and Central California Steelhead (Oncorhynchus mykiss) - Threatened

Central California coast coho salmon and Central California steelhead (hereafter referred to as coho and steelhead) occur in several creeks on the Point Reyes peninsula and in the Lagunitas Creek watershed that drains portions of PRNS and GGNRA. In addition to treatments in the Bolinas Ridge, Highway One, Estero, and Limantour Road FMUs, five new treatment areas are identified in Alternative B. The Wilderness North FMU is included in the Tomales Bay, Drakes Bay, and Drakes Estero watersheds. The Wilderness South FMU is included in the Drakes Bay, Olema Creek, and Pine Gulch Creek watersheds. The Inverness Ridge FMU is included in the Drakes Estero and Tomales Bay Watersheds. The Palomarin FMU is located in the Drakes Bay and Bolinas Drainage watersheds. The Tomales Point FMU is located on the Tomales Bay and Pacific Drainage watersheds (see Figure 16). Designated critical habitat for coho in PRNS includes all accessible estuarine and stream areas in the coastal watersheds of Marin County except areas above longstanding, naturally impassable barriers or above Peters Dam on the mainstem of Lagunitas Creek and Seeger Dam on Nicasio Creek (NMFS, 1999). Although critical habitat has not been established for central California steelhead, it is likely to be the same as that for coho in Marin County.

Tomales Bay Watershed

Under Alternative B, the Limantour Road, Wilderness North, and Inverness Ridge FMUs would be subject to mechanical treatment and prescribed fire. The Tomales Point FMU would be subject to mechanical treatment. These FMUs represent 8% of the total watershed area (see Table 42).

Lagunitas Creek Watershed

Treatment under Alternative B would be the same as under Alternative A.

Olema Creek Watershed

Under Alternative B, the Bolinas Ridge FMU would be subject to prescribed fire while the Highway One FMU would receive both prescribed fire and mechanical treatment within the Olema Creek watershed. These FMUs encompass 20% of the total watershed area (see Table 42).

Drakes Bay Drainages

Under Alternative B, the Limantour Road, Palomarin, Wilderness North, and Wilderness South FMUs would be subject to mechanical treatment and prescribed fire. These FMUs represent 20% of the total watershed area (see Table 42).

Drakes Estero Watershed

Under Alternative B, the Estero, Limantour Road, Inverness Ridge, and Wilderness North FMUs would be subject to mechanical treatment and prescribed fire. These FMUs represent 31% of the total watershed area (see Table 42).

Pacific Drainages

The Pacific drainages do not support threatened salmonid species. Under Alternative B, the Tomales Point FMU would be subject to mechanical treatment.

Bolinas Drainages

Under Alternative B, the Bolinas Ridge FMU would be subject to prescribed fire while the Highway One and Palomarin FMUs would receive both prescribed fire and mechanical treatment within the Bolinas Drainages. These FMUs represent 33% of the total watershed area (see Table 42).

Pine Gulch Creek

Under Alternative B, the Bolinas Ridge FMU would be subject to prescribed fire while the Highway One and Wilderness South FMUs would receive both prescribed fire and mechanical treatment within the Pine Gulch Creek watershed. These FMUs represent 26% of the total watershed area (see Table 42).

Analysis

Under Alternative B, the treatments proposed could affect coho salmon and steelhead trout because eight of the nine FMUs to be treated have one or both species of fish. Highway One FMU has the greatest potential for possible impacts because of its proximity to Olema Creek and Pine Gulch Creek. The FMU surrounds the road corridor and includes more than 8 kilometers of mainstem habitat supporting coho salmon and steelhead trout.

Prescribed Fire

Prescribed fire is more controllable than wildfires, and through the use of mitigation measures identified in the review of each burn plan, impacts would be minimized so they are no more than negligible or minor. For example, riparian vegetation is important in protecting fish and keeping water temperatures lower. Burn plans for fires where coho or steelhead habitat is present would include a no-treatment buffer to protect riparian vegetation. Research indicates leaving a buffer would eliminate any increases in water temperature during or following burning (McMahon and deCalesta, 1990).

High levels of fuel loading in some areas of the park may create hot spots, or prescribed fires that burn at higher than natural intensities. This would decrease over time as more and more acreage is cumulatively treated, but could cause increased run-off and nutrient loads, even when fire prescriptions are designed to minimize high-intensity fires. Some fish species can begin to experience stress at relatively low sediment concentrations of 50 mg/l, but salmonids are know to thrive even in highly turbid rivers. The impacts from any increases in sediment loading resulting from prescribed burning are likely to be no more than minor, and would be short-term, lasting only until slopes are revegetated.

In addition to mitigation measures identified in Alternative A, Mitigation Measure S-2 would need to be considered for treatments in the Bolinas Drainages, Olema Creek, and Pine Gulch Creek watersheds, where the 1,000 acre potential annual treatments exceed more than 10% of the total watershed area. Mitigation Measure S-2 would be triggered when proposed actions have the potential to exceed 10% of the total area of one or more FMP watersheds in one year, which could result in a minor to moderate impact to salmonids in a given watershed. Mitigation Measure S-2 assures that planning considers the watershed scale and, if a potential effect is identified, that specific adjustments to the burn density and schedule are included in the workplan. As shown in Table 42, the combined project acreage must exceed 790 acres in Bolinas Drainages, 939 acres in Olema Creek Watershed, and 506 acres in Pine Gulch Watershed.

Once it is confirmed that an annual plan for prescribed burning would exceed the 10% level of area in these smaller watersheds, Mitigation Measure S-2 requires an interdisciplinary team evaluation, chaired by the Fire Management Officer, to document the plan and identify actions that may reduce the potential burn or mechanical treatment impacts either spatially or temporally.

Prescribed fire, because it is used to restore the natural vegetation structure of park habitats and reduce the risk of catastrophic fire, would have long-term benefits for coho and steelhead by protecting dense riparian habitat for these two species, maintaining vegetated slopes and keeping water temperature in appropriate ranges. This benefit would be limited by the relatively small area that would be burned annually (1000 acres) under Alternative B, but over time this benefit could become quite widespread. Compared to negligible benefits offered under Alternative A, benefits to coho and steelhead from prescribed burning in this alternative would be long-term and minor.

<u>Unplanned Ignitions, Wildfire, and Suppression</u>

No impacts beyond those described for Alternative A from unplanned ignitions or their suppression would be expected.

<u>Mechanical Treatment</u>

Hand thinning and pile burning actions taken to manage prescribed fire would have no-effect or negligible adverse effect on coho and steelhead trout and would not increase sedimentation. The impact is considered negligible or minor because riparian areas and 100 foot buffer strips would not be treated and would reduce or eliminate any sedimentation increase. The benefits offered by mechanical treatment in this alternative by reducing the risk of a catastrophic fire would be greater than those in Alternative A because double the number of acres would be treated.

California Freshwater Shrimp (Synacaris pacifica)- Endangered

The California freshwater shrimp is found in a portion of the main stem of Lagunitas Creek in the Bolinas Ridge FMU.

Analysis

Prescribed Fire

The most important features of the environment inhabited by this species in the park are likely to be the continued presence of a structurally diverse stream environment and slower flowing or pooled water. Each of these is dependent on the presence of intact riparian vegetation. As noted above in the discussion of federally listed fish species and red-legged frogs, prescribed burning is generally not conducted in riparian vegetation. If a particular prescribed fire in the Bolinas Ridge FMU may affect riparian vegetation along Lagunitas Creek, park staff would make use of mitigation measures or other standard practices to ensure no habitat of the California freshwater shrimp is affected either directly or indirectly. In addition, prescribed fire, because it is used to restore the natural vegetation structure of park habitats and reduce the risk and possible extent of catastrophic fire, could offer long-term benefits for shrimp. Because the benefit to shrimp would be localized to sections of the Lagunitas Creek and would cover a small area, they would not be greater than minor as defined in the Methodology section. These benefits could be short- or long-term, depending on whether the treated areas return to natural fire intervals quickly or need additional treatment.

Unplanned Ignitions, Wildfire, and Suppression

No impacts beyond those analyzed in Alternative A would be expected from unplanned ignitions or their suppression in this alternative.

Mechanical Treatment

No mechanical treatment of Bolinas Ridge FMU is planned for this alternative. Therefore, no impact to California freshwater shrimp is anticipated.

Myrtle's Silverspot Butterfly (Speyeria zerene myrtleae) – Endangered

All of the occurrences of Myrtle's silverspot are within the Minimum Management Fire Management Unit, and would not be subject to either prescribed burning or mechanical fuels treatments. The populations could be subject to impacts associated with an unplanned wildfire or by fire suppression activities, but this is unlikely because the populations occur within pastures routinely grazed by cattle where fire is unlikely to carry.

Western snowy plover (Charadrius alexandrinus nivosus) – Threatened

All of the occurrences of western snowy plovers are within the Minimum Management Fire Management Unit, and would not be subject to either prescribed burning or mechanical fuel treatments. The populations could be subject to impacts associated with an unplanned wildfire or by fire suppression activities, but this is unlikely because the plovers occur in beach areas where fire is unlikely to carry.

Additional Special Status Wildlife

As noted above in Alternative A, Pt. Reyes Mountain Beaver is treated separately because it is more likely than other additional special status wildlife species to experience impacts from fire management activities.

Point Reyes Mountain Beaver (Aplondontia rufa phaea)

Analysis

Prescribed Fire

As noted above in the discussion of impacts to mountain beaver from prescribed burning in Alternative A, mountain beaver would be helped rather than harmed by prescribed fire in their habitat. In fact, small burns in mountain beaver habitat are used as mitigation for the effects wildfire can bring when fuels build up. This species was severely affected by the 1995 Vision wildfire, and prescribed burns would reduce the risk and extent of this kind of catastrophic fire recurring. Prescribed burns can also stimulate the growth of forbs and succulent plants used as food by mountain beaver. In this alternative, twice the acreage as in Alternative A would be treated with prescribed burning, including in Inverness Ridge FMU, where mountain beaver habitat exists and was burned in the Vision Fire.

Unplanned Ignitions, Wildfire, and Suppression

Unplanned ignitions and wildfires can burn hotter than prescribed burns, and so can cause major vegetation changes. The mitigation measures identified above would help keep unplanned ignitions from becoming large-scale wildfires, and with them in place impacts to mountain beavers are expected to remain negligible or minor. No changes in impacts from those described in Alternative A are therefore expected from average scope wildfires in the study area.

Mechanical Treatment

Impacts to mountain beavers from noise and the presence of humans during thinning or chipping operations could cause minor adverse impacts. Although these impacts would be more widespread than in Alternative A, they would remain localized and temporary. Mechanical thinning would also reduce the risk of catastrophic wildfire and offer minor benefits to mountain beavers in this regard.

Other Wildlife Species of Concern (excluding Mountain Beaver)

Analysis

Prescribed Fire

Same as Alternative A, adverse and beneficial impacts would also be no more than minor and short-term, but could be more widespread than in Alternative A, again because additional acreage would be burned.

Unplanned Ignitions, Wildfire, and Suppression

No changes in impacts from unplanned ignitions, average annual wildfires or their suppression are expected in this alternative from those described for Alternative A.

Mechanical Treatments

Same as Alternative A, adverse and beneficial impacts would also be no more than minor and short-term, but could be more widespread than in Alternative A, again because additional acreage would be burned.

Effects of Fire Information/Education on Special Status Wildlife

No changes from the possible slight benefits to special status wildlife from fire information and education described in alternative A would occur if this alternative were implemented.

Effects of Fire Cache/Park Headquarters Relocation, and Construction on Special Status Wildlife

No differences between the impacts of Alternative A and this alternative from the building of the fire cache are expected.

Fire Effects and Fuel Management Research on Special Status Wildlife

No differences between the impacts identified in Alternative A and this alternative from fire effects or fuel management research are expected.

Cumulative Impacts

No differences between the cumulative impacts identified in Alternative A and this alternative are expected.

Conclusion

Regarding plants that are federally listed as threatened and endangered species, all of the occurrences of Sonoma alopecurus, Sonoma spineflower, Tiburon paintbrush, Marin dwarf flax, beach layia, and Tidestrom's lupine are within the Minimum Management Fire Management Unit, and would not be subject to either prescribed burning or mechanical fuels treatments. The populations could be subject to impacts associated with an unplanned wildfire or by fire suppression activities, but this is unlikely because the populations occur in wet sites within pastures routinely grazed by cattle where fire is unlikely to carry.

Plant species that are not federally listed, but are of concern would likely continue to receive minor, long-term benefits from prescribed burning and mechanical treatment, and the eventual return of natural fire cycles. Some patches or individuals of these species may experience minor, adverse effects from destruction through fire or suppression, or from the inadvertent stimulation of invasive exotic species burning may sometimes have.

Prescribed fire and mechanical treatments would offer minor, long-term benefits on a limited scale to northern spotted owls, red-legged frogs, and California freshwater shrimp (from fire only) by reducing the threat of catastrophic fire and the habitat destruction it would bring. Mechanical treatments such as hand thinning and pile burning actions taken to manage prescribed fire would have a minor, short-term, adverse effect on owls through possible human disturbance, reduction of prey species, and habitat alteration in unknown roosting and nesting sites, and on frogs from inadvertently killing individuals. No mechanical treatment is planned in the Bolinas FMU, habitat of the freshwater shrimp. Large-scale wildfires could have more serious adverse effects on owls by eliminating habitat, and on frogs by burning riparian vegetation and increasing sedimentation. Both these species experience a positive cumulative impact from the large blocks of conservation land adjacent to the study area.

Adverse impacts to coho salmon and steelhead trout from prescribed burning would be negligible to minor, as riparian vegetation would be retained. Minor positive benefits from reducing the risk and extent of a catastrophic burn would result from both prescribed burning and mechanical thinning. A large-scale wildfire would have more serious adverse effects by increasing siltation of streams and burning riparian vegetation, which in turn would increase water temperature.

Both Myrtle's silverspot butterfly and snowy plovers occur only in the Minimum Management FMU, and so would not be subject to either prescribed burning or mechanical fuel treatments. The populations could be subject to impacts associated with an unplanned wildfire or by fire suppression activities, but this is unlikely because the populations occur within pastures routinely grazed by cattle (silverspot) or beach areas (plover) where fire is unlikely to carry.

The impacts of fire management activities, including those of average size and intensity wildfires in the study area on Point Reyes mountain beaver would be kept to no more than minor and short-term through the use of mitigation measures. Large-scale wildfires could have moderate adverse impacts that may be long-term.

There would be some indirect long-term benefits by conducting research and fire education. There are no adverse impacts to special status species by the construction of the fire cache.

No impairment to park special status species would occur from implementing Alternative B.

Alternative C

Impacts on Federally Listed Plant Species

Analysis

All of the plants identified above in Alternative A as on the federal list of threatened and endangered species are located primarily in the Minimum Management FMU, which is not treated by prescribed fire or mechanical thinning. These species include the Sonoma spineflower, Robust spineflower, Tiburon paintbrush, Marin dwarf flax, beach layia, and Tidestrom's lupine. Although this FMU may have some small wildfires, on average no more than about 30 acres of the entire study area burns in a given year. Since most of these plants are located in areas in well grazed pastures or rocky outcrops, they are unlikely to be burned by wildfires in the park in average years. The impacts of Alternative B are the same as Alternative A on all of these species, with the exception of Sonoma alopecurus, which does occur in the Palomarin FMU. It is treated separately below.

Sonoma alopecurus (Alopecurus aequalis var. sonomensis) – Endangered

Sonoma alopecurus is a perennial grass that grows in the park primarily on pastures in agricultural areas. It favors moist or wet sandy soils.

Other Special Status Plant Species

Analysis

Under Alternative C, 10 FMUs are treated for a total of 3,500 acres. Compared to Alternative B, prescribed fire would be used to treat two additional FMUs - Tomales Point and Headlands. Mechanical treatment would be used in the same FMUs as in Alternative B. Five additional special status plant species of concern grow in the Headlands FMU. These species are perennial goldfields, Point Reyes meadowfoam, North Coast phacelia, Point Reyes rein orchid, and beach starwort.

Prescribed Fire

As noted above, fire is an integral part of the natural ecosystem at Point Reyes and likely plays a critical role in the management of many plant and animal Species of Concern by maintaining open areas or stimulating reproduction. Prescribed burning may kill some individuals of these species, but it would also remove competitive non-native species and therefore would have a beneficial long-term impact. While this benefit would remain minor, it could conceivably be triple or more that of Alternative A depending on the location of populations of each species. Adverse impacts from loss of individuals or small patches of special status plants would also be no more than minor and short-term, but could be more severe or widespread than in Alternative A or B, again because additional acreage would be burned. Prescribed burns in both Tomales Point and Headlands FMUs would be kept small (less than 50 acres), and carefully monitored to determine the response of plant communities, including plants of special concern. In particular, the burns would be monitored to see if they reduce the aerial extent of invasive non-native plants and increase the percentage of natives in the headlands communities.

Unplanned Ignitions, Wildfire, and Suppression

No changes in impacts from unplanned ignitions, average annual wildfires, or their suppression are expected in this alternative from those described for Alternative A.

Mechanical Treatments

Mechanical treatment would be used to accomplish the same objectives in this alternative as in Alternative B - that is, primarily to help control non-native species and to prepare wooded areas for prescribed burning. Although the extent of mechanical treatment would increase in this alternative over both A and B, it is not expected have any adverse impacts on special status plants as mowing would be done in the fall and rare plants populations would be excluded from treatment areas.

Fire Information/Education

No impact to any plant special status species is expected from the distribution of fire information or education.

Fire Cache/Park Headquarters Relocation, and Construction

Because the area where the fire cache is planned would be surveyed prior to construction, impacts to protected plant species would be minimized. It is possible that individuals would be affected, but the extent of the effect would be minor.

Fire Effects and Fuel Management Research

In addition to small controlled burns in Bolinas Ridge and Palomarin FMUs to increase native species richness, a study of the effects of prescribed burning on fragrant fritillary in Limantour Road FMU would take place under this alternative. Also, the effects of both prescribed burning and mechanical treatment on Marin manzanita would be assessed in the Wilderness South FMU. If treatment is successful, minor positive benefits to these species could result in the long run.

Special-Status Wildlife

Northern Spotted Owl (Strix occidentalis caurina) – Threatened

Prescribed Fire

Under Alternative C, potential effects on northern spotted owls are greater than Alternative A because more acres (1,500) are being treated that are considered habitat and possible disturbance could occur.

As noted in Alternative A, fuels have built up in spotted owl habitat to the point that a catastrophic, stand-replacing fire is more likely. Such as fire would destroy spotted owl habitat for many years; prescribed burning is considered an important tool in helping to reduce these unnatural accumulations of fuels and ladder fuels and preserve owl habitat.

Preparatory burns and mechanical fuel reduction would be used to control fire intensity in areas in owl habitat, and no treatment would occur within 400 meters of a nesting or known roosting site. Spring prescribed fires in the moist conditions of old growth forests would also minimize damage, yet reduce fuel loads (Weatherspoon et al., 1992). Prescribed fire planning also takes into account other important habitat components, such as down, woody debris that provide habitat for dusky-footed woodrats, which are an important prey species for northern spotted owls in the project area. If a prescribed burn does reduce the amount of woody debris, or would otherwise adversely affect woodrat habitat or nests, it would have an indirect minor, short-term, adverse effect on spotted owls.

Currently, no program elements exist for the management of prescribed fires for the benefit of spotted owls. The use of prescribed fire under Alternative C, would, nonetheless, have a beneficial, long-term, and minor impact on northern spotted owls, primarily through reduction in the threat of catastrophic fire in some areas.

Unplanned Ignitions, Wildfire, and Suppression

No impacts different than those described above for Alternative A would result from unplanned ignitions, wildfires or suppression in Alternative C. To sum, because average annual acreage burned from wildfires at the park is quite low, any more than minor adverse impacts from average annual wildland fires is unlikely.

Mechanical Treatments

Under Alternative C, hand thinning or mechanical treatments in the vicinity of development and roads such as on Bolinas Ridge, Wilderness North, Wilderness South, and Highway One FMUs could have an adverse effect on spotted owls if canopy closure was substantially reduced. This is especially true where developed areas interface with dense forest that provides roosting and nesting habitat. Under Alternative B, cutting large trees would be limited because techniques would be confined to hand thinning and then piling and burning. In some areas, clearing understory vegetation could, in fact, improve foraging conditions for spotted owls and habitat for it prey item - woodrats. Overall, impacts would remain localized and therefore minor.

Chipping conducted under Alternative C would be greater than Alternative A or B. Chipping cut material and then distributing it over a site could occur where air quality, visitor use, or other management concerns prohibit burning. The equipment used to chip material is extremely loud and, if operated nearby, may disturb spotted owls. Although more chipping would take place in this alternative, impacts to owls would still be localized and temporary, and would therefore be no more than minor.

Fire Information/Education

No impact to spotted owls from the distribution of fire information or education is expected.

Fire Cache/Park Headquarters Relocation, and Construction

The fire cache would not be located in the vicinity of spotted owl activity centers or potential habitat, so no impact is expected.

Fire Effects and Fuel Management Research

No effects to spotted owls from fuel management research under Alternative C are expected.

Red-legged Frog (Rana aurora draytonii) – Threatened

Analysis

Prescribed Fire

Prescribed fire, because it is used to restore the natural vegetation structure of park habitats and reduce the risk of catastrophic fire, would have a long-term benefit to red-legged frogs and their habitat. Because red-legged frogs are widely disturbed among several FMUs in the study area, the benefits of prescribed burning and returning habitat to a more natural fire intensity and interval could be moderate.

As noted in Alternatives A and B, until broad areas have been treated, fuel loading may remain high and prescribed fires may burn at higher than natural intensities, even when fire prescriptions were designed to minimize high-intensity fires. These fires could kill individual frogs or have short-term adverse effects on frog habitat. Because of monitoring and avoidance of known frog habitat, adverse impacts would be negligible.

Unplanned Ignitions, Wildfire, and Suppression

The same short-term and negligible adverse impacts from small wildfires as described in Alternative A would be possible in this alternative as well.

Mechanical Treatment

Mechanical treatment such as hand thinning, line construction, and pile burning could disturb frogs or alter their habitat. However, impacts would be no more than negligible because breeding areas and adjacent non-breeding areas would be identified and avoided before any mechanical treatment is taken.

Reduction in fuel loading by hand thinning or mechanical treatment would have a negligible, long-term, minor effect on red-legged frogs by reducing fuel loads and the threat of catastrophic fire.

Central California Coast Coho Salmon (Oncorhynchus kisutch) – Threatened and Central California Steelhead (Oncorhynchus mykiss) - Threatened

Central California coast coho salmon and Central California steelhead (hereafter referred to as coho and steelhead) occur in several creeks on the Point Reyes peninsula and in the Lagunitas Creek watershed that drains portions of PRNS and GGNRA. In addition to treatments in the Bolinas Ridge, Highway One, Estero, Limantour Road, Wilderness North, Wilderness South, Inverness Ridge, Palomarin, and Tomales Point FMUs, one new treatment area is identified in Alternative C. The Headlands FMU is included in the Drakes Bay and Pacific Drainage watersheds(see Figure 16). Designated critical habitat for coho in PRNS includes all accessible estuarine and stream areas in the coastal watersheds of Marin County except areas above longstanding, naturally impassable barriers or above Peters Dam on the mainstem of Lagunitas Creek and Seeger Dam on Nicasio Creek (NMFS, 1999). Although critical habitat has not been established for central California steelhead, it is likely to be the same as that for coho in Marin County.

<u>Tomales Bay Watershed</u>

Under Alternative C, all treatment would be the same as those evaluated in Alternative B.

<u>Lagunitas Creek Watershed</u>

Under Alternative C, the Bolinas Ridge FMU would be subject to prescribed fire and mechanical treatment. This FMU represents 3% of the total watershed area (see Table 42).

<u>Olema Creek Watershed</u>

Under Alternative C, all treatment would be the same as those evaluated in Alternative B.

<u>Drakes Bay Drainages</u>

Under Alternative C, most treatments would be the same as those evaluated in Alternative B. In addition, the Headlands FMU would be subject to prescribed fire. These FMUs represent 24% of the total watershed area (see Table 43).

<u>Drakes Estero Watershed</u>

Under Alternative C, all treatment would be the same as those evaluated in Alternative B.

Pacific Drainages

The Pacific drainages do not support threatened salmonid species. Under Alternative C, most treatments would be the same as those evaluated in Alternative B. In addition, the Headlands FMU would be subject to prescribed fire.

Bolinas Drainages

Under Alternative C, all treatment would be the same as those evaluated in Alternative B.

Pine Gulch Creek

Under Alternative C, all treatment would be the same as those evaluated in Alternative B.

Analysis

Under Alternative C, the treatments proposed could affect coho salmon and steelhead trout because eight of the ten FMUs to be treated have one or both species of fish. Highway One FMU has the greatest potential for possible impacts because of its proximity to Olema Creek and Pine Gulch Creek. The FMU surrounds the road corridor and includes more than 8 kilometers of mainstem habitat supporting coho salmon and steelhead trout. Although these are the same FMUs with these species as are treated in Alternative B, more acres would be affected and so the potential for impact, both positive and adverse, is greater.

Prescribed Fire

As in other alternatives, mitigation measures including S-1 and S-2, identified in the review of each burn plan, to evaluate the erosion control plan and retain riparian vegetation would keep adverse impacts from prescribed fire minimized so they are no more than negligible or minor. Initially, high levels of fuel loading in some areas of the park may create hot spots, or prescribed fires that burn at higher than natural intensities, with resulting increases in sedimentation. This would decrease over time at a rate that is faster in this alternative than any other as more and more acreage is cumulatively treated. The impacts from any increases in sediment loading resulting from prescribed burning are likely to be no more than minor, and would be short-term, lasting only until slopes are revegetated.

Prescribed fire, because it is used to restore the natural vegetation structure of park habitats and reduce the risk of catastrophic fire, would have long-term moderate benefits for coho and steelhead by protecting dense riparian habitat for these two species, maintaining vegetated slopes, controlling sediment, and keeping water temperature in appropriate ranges.

Unplanned Ignitions, Wildfire, and Suppression

No impacts beyond those described for Alternative A from unplanned ignitions or their suppression would be expected.

Mechanical Treatment

Hand thinning and pile burning actions taken to manage prescribed fire would have no-effect or negligible adverse effect on coho and steelhead trout and would not increase sedimentation. The impact is considered negligible or minor because riparian areas and 100 foot buffer strips would not be treated and would reduce or eliminate any sedimentation increase. The benefits offered by mechanical treatment in this alternative by reducing the risk of a catastrophic fire would be greater than those in Alternative A or B and would approach moderate levels as defined in Methodology because these benefits would be widespread.

California Freshwater Shrimp

The California freshwater shrimp is found in a portion of the main stem of Lagunitas Creek in the Bolinas Ridge FMU.

Analysis

Prescribed Fire

As noted above, prescribed burning is generally not conducted in riparian vegetation. If a particular prescribed fire in the Bolinas Ridge FMU may affect riparian vegetation along Lagunitas Creek, park staff would make use of mitigation measures or other standard practices to ensure no habitat of the California freshwater shrimp is affected either directly or indirectly. In addition, prescribed fire, because it is used to restore the natural vegetation structure of park habitats and reduce the risk and possible extent of catastrophic fire, could offer benefits for shrimp. Because these benefits could extend over the entire range of shrimp habitat in the park, they may be long-term and moderate as defined in the Methodology section.

Unplanned Ignitions, Wildfire, and Suppression

No impacts beyond those analyzed in Alternative A would be expected from unplanned ignitions or their suppression in this alternative.

Mechanical Treatment

No mechanical treatment in Bolinas Ridge FMU is planned under Alternative C.

Myrtle's Silverspot Butterfly (Speyeria zerene myrtleae) – Endangered

All of the occurrences of Myrtle's silverspot are within the Minimum Management Fire Management Unit, and would not be subject to either prescribed burning or mechanical fuels treatments. The populations could be subject to impacts associated with an unplanned wildfire or by fire suppression activities, but this is unlikely because the populations occur within pastures routinely grazed by cattle where fire is unlikely to carry.

Western snowy plover (Charadrius alexandrinus nivosus) – Threatened

All of the occurrences of western snowy plovers are within the Minimum Management Fire Management Unit, and would not be subject to either prescribed burning or mechanical fuel treatments. The populations could be subject to impacts associated with an unplanned wildfire or by fire suppression activities, but this is unlikely because the plovers occur in beach areas where fire is unlikely to carry.

Other Wildlife Species of Concern

Mountain beaver is treated separately in this section because it may experience impacts from fire management activities.

Point Reyes Mountain Beaver (Aplondontia rufa phaea)

<u>Analysis</u>

<u>Prescribed Fire</u>

As noted above in the discussion of impacts to mountain beaver from prescribed burning in Alternative A, mountain beaver would be helped rather than harmed by prescribed fire in their habitat. In fact, small burns in mountain beaver habitat are used as mitigation for the effects wildfire can bring when fuels build up. This species was severely affected by the 1995 Vision wildfire, and prescribed burns would reduce the risk and extent of this kind of catastrophic fire recurring. Prescribed burns can also stimulate the growth of forbs and succulent plants used as food by mountain beaver. In this alternative, 2000 acres would be treated with prescribed burning, including in Inverness Ridge FMU, where mountain beaver habitat exists and was burned in the Vision Fire. Small prescribed burns conducted over a wide area of beaver habitat would result in minor benefits by maintaining suitable habitat and reducing potential for catastrophic wildfire.

<u>Unplanned Ignitions, Wildfire, and Suppression</u>

Unplanned ignitions and wildfires can burn hotter than prescribed burns, and so can cause major vegetation changes. The mitigation measures identified above would help keep unplanned ignitions from becoming large-scale wildfires, and with them in place impacts to mountain beavers are expected to remain negligible or minor. No changes in impacts from those described in Alternative A are therefore expected from average scope wildfires in the study area.

<u>Mechanical Treatment</u>

Impacts to mountain beavers from noise and the presence of humans during thinning or chipping operations could cause minor adverse impacts. Although these impacts would be more widespread than in Alternative A, they would remain localized and temporary. Mechanical thinning would also reduce the risk of catastrophic wildfire and offer minor benefits to mountain beavers in this regard.

Other Wildlife Species of Concern (excluding Mountain Beaver)

Analysis

<u>Prescribed Fire</u>

Same as Alternative A, adverse and beneficial impacts would also be no more than minor and short-term, but could be more widespread than in Alternative A and Alternative B, because additional acreage would be burned under Alternative C.

<u>Unplanned Ignitions, Wildfire, and Suppression</u>

No changes in impacts from unplanned ignitions, average annual wildfires or their suppression are expected in this alternative from those described for Alternative A.

<u>Mechanical Treatments</u>

Same as Alternative A, adverse and beneficial impacts would also be no more than minor and short-term, but could be more widespread than in Alternative A and Alternative B, again because additional acreage would be treatment by mechanical means.

<u>Effects of Fire Information/Education on Special Status Wildlife</u>

No changes from the possible slight benefits to special status wildlife from fire information and education described in alternative A would occur if this alternative were implemented.

<u>Effects of Fire Cache/Park Headquarters Relocation, and Construction on Special Status Wildlife</u>

No differences between the impacts of Alternative A and this alternative from the building of the fire cache are expected.

<u>Fire Effects and Fuel Management Research on Special Status Wildlife</u>

No differences between the impacts identified in Alternative A and this alternative from fire effects or fuel management research are expected.

Cumulative Impacts

No differences between the cumulative impacts identified in Alternative A and this alternative are expected.

Conclusion

Regarding plants that are federally listed as threatened and endangered species, all of the occurrences of Sonoma alopecurus, Sonoma spineflower, robust spineflower, Tiburon paintbrush, Marin dwarf flax, beach layia, and Tidestrom's lupine are within the Minimum Management Fire Management Unit, and would not be subject to either prescribed burning or mechanical fuels treatments. The populations could be subject to impacts associated with an unplanned wildfire or by fire suppression activities, but this is unlikely because the populations occur in wet sites within pastures routinely grazed by cattle where fire is unlikely to carry.

Plant species that are not federally listed, but are of concern would likely continue to receive minor long-term benefits from prescribed burning and mechanical treatment, and the eventual return of natural fire cycles. Some patches or individuals of these species may experience minor, adverse effects from destruction through fire or suppression, or from the inadvertent stimulation of invasive exotic species burning may sometimes have.

Prescribed fire and mechanical treatments would offer moderate, long-term benefits on a limited scale to northern spotted owls, red-legged frogs, and California freshwater shrimp (from fire only) by reducing the threat of catastrophic fire and the habitat destruction it would bring. Mechanical treatments such as hand thinning and pile burning actions taken to manage prescribed fire would have a minor, short-term, adverse effect on owls through possible human disturbance, reduction of prey species, and habitat alteration in unknown roosting and nesting sites, and on frogs from inadvertently killing individuals. No mechanical treatment is planned in the Bolinas FMU, habitat of the freshwater shrimp. Large-scale wildfires could have more serious adverse effects on owls by eliminating habitat, and on frogs by burning riparian vegetation and increasing sedimentation. Both these species experience a positive cumulative impact from the large blocks of conservation land adjacent to the study area.

Adverse impacts to coho salmon and steelhead trout from prescribed burning would be negligible to minor, as riparian vegetation would be retained. Moderate benefits from reducing the risk and extent of a catastrophic burn would result from both prescribed burning and mechanical thinning. A large-scale wildfire would have more serious adverse effects by increasing siltation of streams and burning riparian vegetation, which in turn would increase water temperature.

Both Myrtle's silverspot butterfly and snowy plovers occur only in the Minimum Management FMU, and so would not be subject to either prescribed burning or mechanical fuel treatments. The populations could be subject to impacts associated with an unplanned wildfire or by fire suppression activities, but this is unlikely because the populations occur within pastures routinely grazed by cattle (silverspot) or beach areas (plover) where fire is unlikely to carry.

The impacts of fire management activities, including those of average size and intensity wildfires in the study area on Point Reyes mountain beaver would be kept to no more than minor and short-term through the use of mitigation measures. Large-scale wildfires could have moderate adverse impacts that may be long-term.

There would be some indirect long-term benefits by conducting research and fire education. There are no adverse impacts to special status species by the construction of the fire cache.

No impairment to park special status species would occur from implementing Alternative C.

IMPACTS TO CULTURAL RESOURCES

Alternative A

Analysis

Several factors influence the degree of damage a cultural resource might experience as a result of the actions in a particular alternative. Some of these factors are discussed below for the actions of prescribed or wildland fire (direct effects), operations such as the use of equipment during thinning (operational effects), and from actions that result from fire or mechanical thinning, called "indirect effects." Indirect effects occur later in time than the fire itself but result from the fire or thinning. Examples of indirect effects include erosion of artifacts following the loss of vegetation in a fire, long-term deterioration of a structure related to damage initially suffered during a fire, etc.

The intensity of a fire and susceptibility of resources to heat is one factor that ultimately determines the degree of damage from the direct effect of fire. For example, obsidian hydration rinds are generally impacted at temperatures in excess of 100 to 150° C, dimensional lumber ignites at 350° C, glass melts at around 500° C, and cast iron at 1400° C. The degree to which duration of heating plays a role is less well understood, but in general, the longer a resource is exposed to heat, the greater the likelihood of damage. Fire can result in the complete elimination of an artifact or feature (e.g., through consumption), or can alter attributes of an artifact or feature such that important research (e.g., obsidian hydration rinds, residues on pottery, bone burning) is hindered, or traditional (e.g., Native American spiritual sites), or other values are impacted.

Fires tend to burn in a complex manner depending on fuels, weather, and terrain (Ryan and Noste, 1985). Fire intensity is generally greater under conditions of heavier fuel (e.g., dead and down timber, brushfields), low fuel moisture, high air temperatures, high winds, low humidity, and/or rugged terrain. It is the behavior of a fire (ground, surface, and crown) and proximity to a cultural resource that determines the amount and type of damage that could occur. While running surface fires and crown fires reach extreme temperatures (500 to 1500° C) and have high energy release rates, relatively little of that heat is directed towards the surface of the ground, and ground fires can result in long duration heating (400 to 700° C) within the upper 15 cm. of the soil profile. Only under rare conditions (e.g., burning tree roots) will elevated temperatures penetrate more deeply beneath the ground surface. Ground or creeping active surface fires are usually associated with prescribed burns, whereas running surface and crown fires occur primarily during wildfires. Very generally, cultural resources located above the ground surface (e.g., rock imagery panels, historical structures) are most vulnerable to direct fire effects during crown and active surface fires, while ground and creeping surface fires threaten those found at or just below the ground surface (e.g., archeological sites). Because of this, the chances of adversely affecting a high percentage of cultural resources found exclusively on or near the ground surface are often greater. This is significant because cultural resources generally considered to have high data potential, such as Native American villages with subsurface components, may actually have a far lower percentage of artifact classes or attributes exposed to direct fire effects than a lithic scatter, often considered to have low data potential that is restricted to the ground surface. While it is the village that would probably receive the greatest amount of attention in regard to a planned or unplanned fire management action, it is the lithic scatter that has the potential to undergo the greatest intensity of impact.

In general, direct effects of fire management actions on cultural resources would be adverse. This is particularly true of archeological resources, structures, and museum objects. While direct fire effects can also adversely impact ethnographic resources and cultural landscapes, fire can also be used to restore, enhance and maintain them. For example, in regard to ethnographic resources, some plants important for basketmaking benefit from the proper application of fire (Anderson, 1999). In cultural landscapes with a vegetation component, fire can be applied to replicate and maintain historic scenes. Adverse direct effects are more likely to occur during extreme fire behavior such as wildfires, although cultural resources with high vulnerability to fire are susceptible to low intensity burns often associated with prescribed fire.

Operational effects to cultural resources are most likely to occur as a result of fire management actions associated with prescribed burns, wildfires and mechanical thinning. The operational effects on cultural resources have been quantified in only a relatively few cases. However, several generalizations can be made:

Impacts resulting from the operation of heavy equipment on and in close proximity to cultural resources will correlate directly with the nature and extent of the disturbance, nature of local sediments, and nature and extent of cultural resources. Heavy equipment would not be used except to help extinguish a wildfire.

With the exception of those that result in more intense fire behavior (e.g., slash piles, firing techniques), impacts resulting from operational effects would generally be restricted to the displacement, breakage and/or destruction and looting of cultural resources. In this sense, operational effects tend to be less encompassing than direct effects. For example, an obsidian projectile point displaced by construction of a fire line would probably retain its hydration rind, morphology, and other attributes.

Except in rare situations, operational effects are likely to be most pronounced on cultural resources found on and near the ground surface.

Operational effects would be most likely to occur, and at the greatest intensity, during wildfires. This is due primarily to the fact that such actions are often carried out with little or no pre-planning and without consultation or supervision by a cultural resource specialist.

Operational effects of fire management actions on cultural resources would, in most cases, be adverse. However, the degree of impact depends greatly on the nature of the operation and the cultural resource or resources in question. Adverse operational effects are of particular concern during and after wildfire events. With proper planning, operations can also be used for beneficial purposes. For example, mechanical thinning can effectively remove hazardous fuels from and in the vicinity of cultural resources, as well as restore, enhance or maintain ethnographic resources and cultural landscapes, in cases where the risk of direct effects is too high.

Indirect effects may be delayed and incremental, and are related most strongly to the intensity of the fire management effort, although context and the nature of the resource play important roles. For example, intense fire behavior and major suppression efforts associated with wildfires would often mean indirect effects, such as loss through erosion, would occur relatively quickly and to a larger degree than following a smaller prescribed burn or mechanical thinning. Over time, these smaller actions can have adverse consequences of similar magnitude to wildfire suppression. The indirect effects of fire management actions related to high intensity wildfires would be generally adverse.

As noted in Affected Environment, cultural resource surveys as Point Reyes are not 100% complete. The areas that are less likely to have been surveyed are those that are difficult to access, either because of rugged topography, thick vegetation or both. Because these areas have not been surveyed, they are vulnerable to the loss of resources and information during what could be quite intense burns. On the other hand, settlement in the area has by in large taken place where topography is less steep, along fresh and saltwater sources, and vegetation is not dense, and it is these areas where cultural resource data is more likely to have been recorded. The combination of less dense vegetation and more intense surveys in these areas mean these resources are not likely to suffer more than minor or moderate impacts, even in a wildland fire.

<u>Mitigation Measures</u>

Mitigation measures are actions that reduce the impact of the planned activities on a particular resource. In this case, all of the measures listed below would be employed at Point Reyes National Seashore, and would be part of agreements between state and federal cultural resource protection agencies and the NPS. They are divided in measures taken before actions in the alternatives (prescribed fire or thinning, suppression of unplanned ignitions) occur, during these actions and following them. Because they are mandatory, the alternatives are analyzed assumed each would be put into place.

Pre-Action

Cultural resources would be considered during all fire management planning efforts.

Fire management personnel and other staff would receive annual training on cultural resources and fire management actions.

All cultural resources would be evaluated with respect to hazardous fuel loads. As needed, fuel loads would be reduced using methods commensurate with avoiding or minimizing adverse effects. Maintaining light fuel loads on and in close proximity to cultural resources would be emphasized. All areas slated for ground disturbing activities would be subjected to pre-action field surveys. This includes areas likely to be disturbed during future wildfires.

Pre-burn survey would be conducted prior to all prescribed burns as dictated by resource distribution and vulnerability, vegetation and topography, and expected fire behavior.

Consultation with local Native American communities would continue to occur in the context of fire management actions. Spiritual sites and important plant communities would be identified and appropriately managed for preservation, maintenance, and/or enhancement.

Computer and other databases containing cultural resources data would be created and maintained, and made available to fire management personnel in the event of emergencies.

Cultural resources specialists from adjacent land management agencies would be consulted in order to coordinate mitigation efforts prior to planned and unplanned fire management actions.

Appropriate cultural resources monitoring protocols would be established and implemented.

Potential research opportunities to study the effects of fire management actions on cultural resources would be identified.

During-Action

A cultural resource specialist or resource advisor would be present during all fire management actions where recorded and unrecorded resources of interest are considered at risk. Additional surveys would be conducted on an as-needed basis.

Observations of fire behavior and other variables would be made with respect to recorded cultural resources and/or areas with high probability of containing unrecorded cultural resources.

Cultural resources data would be shared with fire management personnel as needed to avoid or minimize adverse effects.

A cultural resource specialist or resource advisor would educate fire management personnel about cultural resources and the potential impacts of fire management actions.

Post-Action

The post-action condition of all recorded cultural resources would be assessed. Resources requiring stabilization or other treatment would be mitigated.

As appropriate, post-action survey would be conducted in previously surveyed and unsurveyed areas. Previously unrecorded cultural resources would be assessed for condition, and stabilization and other protection needs.

Monitoring and research data would be compiled, evaluated, and used to help refine cultural resource compliance for fire management actions.

Prescribed Fire

Under this alternative, a maximum of 500 acres/year, which would all be treated in Estero, Limantour Road, Highway One, and Bolinas Ridge FMUs, would be burned using prescribed fire. This is the same as under existing conditions.

Prescribed burning could offer some benefits to cultural resources. For example, areas that are to be burned are surveyed, and staff can locate and evaluate the significance of cultural resources they would not otherwise have had an opportunity or reason to assess. The ability to conduct pre-burn inventories also allows the park to quantitatively and spatially document fuel conditions and require mechanical treatment of particularly dense vegetation to avoid damage to important cultural sites. If this is not possible, the information about fuel conditions can be used to direct post-burn survey and more meaningfully assess damage to cultural resources that could not be mitigated prior to the burn. These benefits are expected to be minor because it is not expected that significant archeological or historic resources will be found. In addition, prescribed burns can be conducted in areas to obtain cultural landscape objectives, offering long-term and short-term moderate benefits if a landscape is restored. The benefit is moderate because prescribed burning could provide a measured change in the significant characteristic of the landscape. For example, prescribed burning could open up a historic view-shed (part of a cultural landscape) that has been lost because of vegetation growth.

Prescribed burns can also be used to improve conditions at or safety of a cultural resource, and in particular of historic buildings. For example it is possible, through varied timing or operational procedures (e.g., heading or backing fire) to achieve lower or higher fire intensities. A low intensity fire might be utilized on or immediately adjacent to a particular cultural resource such as a historic structure; while a high intensity fire could significantly reduce hazardous fuels surrounding the resource. Prescribed burns are implemented at times when the likelihood of escape is low, thereby minimizing potential effects to those cultural resources in close proximity to a burn unit. Reducing fuel loads from around historic structures could offer short-term moderate benefits for cultural resources.

As noted above, a standard mitigation measure for prescribed burns in the park is the presence of a cultural resource specialist, who would be able to monitor fire behavior and the effectiveness of mitigation measures during the burn for future reference. The specialist would also be on site in the case of an escape to help mitigate or minimize potential adverse effects of suppression.

Preparation activities, such as line construction, would also be monitored by a cultural resource specialist. The specialist would survey the site where these activities are planned and collaborate on the best location for them, monitor construction to ensure minimal damage, and brief fire personnel on the proper protocol in and around cultural resources. The presence of a specialist is likely to keep impacts to archeological sites from these activities low, so they are no more than minor and short-term.

The benefit of pre-burning planning allows the cultural resources specialist to account for potential indirect effects. For example, if high tree mortality is a concern following the burn, efforts can be taken to reduce the number of trees in proximity to a cultural resource. Some indirect effects like erosion are exacerbated by intense fire behavior, the type that is unlikely to occur over large areas during prescribed burns.

Unplanned Ignitions, Wildfire, and Suppression

Due to often extreme fire behavior, the direct effects of wildfires on cultural resources can be substantial, including adverse damage. However, at Point Reyes, an average of only three small (less than 10 acres/year) unplanned ignitions has taken place for most years, although very large fires can occur under unusual conditions. As these are unplanned events, cultural resource specialists rarely have the luxury of benefits conveyed by pre-planning efforts during wildfires. For example, because all of the park has not been intensely surveyed (approximately 87% of the park has not been surveyed; however, the 13% surveyed covers the most likely areas for archeological sites) of Point Reyes has been fully inventoried for cultural resources, it is highly likely that wildfires will occur in areas that lack or have few recorded cultural resources.

Information regarding direct effects would in most cases be obtained during the post-burn phase, and involve evaluating those effects on resources for which no pre-burn condition data were available. It is possible that an uncontrolled large wildfire could destroy or remove all information from cultural resources or have a short- or long-term effect on the integrity of cultural landscapes. See impacts section under Cumulative Impacts below.

Operational effects associated with wildfire suppression can often be adverse, major, and permanent. The acts of constructing fire lines with a dozer, helispots, staging areas, mopping-up and other ground disturbing processes can have major adverse permanent impacts on cultural resources, particularly those that are on the ground or buried. Even with low impact techniques, the placement of fire lines and related phenomenon can be quite unsystematic when compared to planned fire management actions. Although the use of heavy equipment for fire suppression is prohibited unless authorized by the Point Reyes superintendent, it is a standard tool for agencies charged with fire management on adjacent lands, and would almost certainly be employed in cases where life or property was at risk.

Large numbers of personnel, from varied backgrounds, are present at any fire. Crews are often spread across a vast area. Cultural resource looting and vandalism can potentially occur during wildfire events. However, these adverse impacts would be minor because most archeological sites have been recorded and surface artifacts removed. In addition, NPS resource advisors would be on-site quickly after a burn to ensure looting and vandalism does not occur.

During suppression activities some cultural landscape elements may be altered. However, most would be a temporary alteration that could be restored and most suppression activities would not alter a significant number of characteristics of a particular cultural landscape. Therefore, by suppression activities, cultural landscapes would have short-term, minor, adverse effects because a small percentage of the historic landscapes would likely to be lost and should not last more than 10 years.

To sum, from uncontrolled wildfire this alternative could have permanent adverse major effects to historic buildings due to loss during an uncontrolled wildfire. Archeological sites may receive permanent, adverse, major from suppression effort because heavy equipment such as a tractor and blade may inadvertently impact a archeological or historical site. Cultural landscapes would have only short-term, minor, adverse effects because a small percentage of the historic landscapes would likely to be lost and should not last more than 10 years. For impacts under a large-scale fire, see Cumulative Impacts section below.

Mechanical Treatments

Under this alternative, 500 acres/year in Estero, Limantour Road, Highway One, and Bolinas Ridge FMUs would be treated by mechanical means.

Although fire itself is not technically a component of mechanical treatments, prescribed burning of vegetation piles would be undertaken. Fuel loads in these piles would be substantial, would tend to burn at very high intensities, and any cultural resources found in proximity would almost certainly suffer direct effects. With the ability to pre-plan, the cultural resource specialist can ensure that piles are not created on or near cultural resources, and impacts would be no more than minor.

Operational effects present the greatest concern in regard to the potential impacts of mechanical treatment. Ground disturbance could result in substantial impacts to cultural resources. However, mechanical treatments offer the benefit of pre-planning in that the location(s) of ground disturbance can be specifically delineated, and known cultural resources avoided. In the event that an area cannot be subjected to adequate pre-burn survey due to thick vegetation, a cultural specialist could monitor the mechanical treatment for cultural resources that become exposed. Likewise, less intensive mechanical treatments can be employed in highly sensitive areas. While looting by fuels crews is also a concern, these effects could be minimized through a combination of education and avoiding known resources. Together, these activities would prevent impacts to archeological resources from mechanical thinning from becoming more than short-term and minor.

A variety of indirect effects could arise as a result of mechanical treatments. The use of heavy equipment could result in soil compaction, and potential soil erosion on and near cultural resources. The act of thinning vegetation on or near cultural resources might leave them vulnerable to looting. Again, however, the ability to perform pre-treatment survey means that equipment can be excluded from or near cultural resources and vegetation can be strategically left in place to discourage looting. Mechanical treatments also offer the potential short-term moderate benefit of reducing fuel loads in proximity to cultural resources. They would also offer long-term moderate benefits by restoring and/or maintaining historical scenes associated with structures and cultural landscapes, especially in situations where it is not desirable or possible to accomplish these tasks with the direct application of fire.

Fire Information/Education

Impacts associated with fire information and education would largely be beneficial, although highly dependent on the nature of the fire management action. Pre-planned events such as prescribed fires and mechanical treatment provide the opportunity to demonstrate the effectiveness of cultural resources compliance to local Native American communities and the interested public. During unplanned events, such as wildfires time for effective communication is often more limited and can be more controversial since resources are often damaged.

Fire Cache/Park Headquarters Relocation, and Construction

The construction of a fire cache at Bear Valley would have no influence on the direct effects of fire management actions on cultural resources. However, relocating fire management personnel to a more centralized location would allow for faster response time to cultural resources in the event of wildfires.

Operational effects associated with the construction of the new fire cache are unlikely to occur. The Bear Valley developed area has been surveyed in its entirety on several occasions (Kelly, 2003) and no cultural resources have been documented at the proposed fire cache location.

No adverse or beneficial indirect effects are anticipated with the construction of the new fire cache.

No adverse or beneficial effects are anticipated with the construction of the new fire cache on historic structures, archeological sites, or cultural landscapes.

Fire Effects and Fuel Management Research

No adverse or beneficial effects are anticipated on cultural resources from the implementation of Alternative A research projects. All historic structures, archeological sites, or cultural landscapes would be avoided and treated areas located away from any known sites.

Cumulative Impacts

Based on an analysis of the list of projects in Appendix C, the cumulative impacts of all the projects listed would not change the potential intensity or duration of the impacts to cultural resources. Most of the projects building projects listed have beneficial effects on cultural resources. However, a large-scale high-intensity, uncontrolled fire such as the 1995 Vision would dramatically increase all impacts to cultural resources (see impacts above). Extremely high fire temperatures can be expected, with the implication that even the most durable cultural resources are vulnerable to major, permanent damage. A large number of significant historic structures could be loss and soil erosion from hydrophobic soils could severely damage archeological resources. Large fires would often encompass a high number of cultural resources including historic structures, cultural landscapes, and archeological sites resulting in permanent, major, adverse cumulative effect.

Conclusions

Alternative A would have short-term, moderate, beneficial effects to historic buildings by reducing fuels around these structures, both through prescribed burns and mechanical treatment. Moderate, long-term, benefits to cultural landscapes from the restoration or maintenance of them through prescribed fire or mechanical treatments are also likely. Mitigation measures would keep impacts to archeological resources (from pre-treatment for prescribed burns, or mechanical thinning activities) from becoming more than short-term and minor.

Suppression activities associated even with smaller, more average sized wildfires could have negligible to major permanent major adverse effects to cultural resources because no pre-planning occurs and suppression, rather than resource protection, is the top priority. Archeological sites could have permanent adverse major from suppression effort because heavy equipment such as a tractor and blade may inadvertently impact an archeological or historical site. Cultural landscapes would have only short-term, minor, adverse effects from average wildfires because a small percentage of the historic landscapes would likely to be lost and should not last more than 10 years.

No adverse or beneficial effects are anticipated with the construction of the new fire cache or implementing research activities on historic structures, archeological sites, or cultural landscapes.

A large-scale uncontrolled wildfire as described in the Cumulative Impact section could have long-term, major, adverse effects to historic buildings and cultural landscapes due to significant loss of numerous historic features and structures. The alternative would not result in long-term impairment to cultural resources.

Alternative B

Analysis

The same type of activities as described above for Alternative A would take place. However, up to 1000 acres/year in 8 FMUs including Estero, Inverness Ridge, Limantour Road, Wilderness North, Wilderness South, Highway One, Bolinas Ridge, and Palomarin would take place. Mechanical treatments of 1000 acres/year could occur in FMUs at Tomales Point, Estero, Limantour Road, Wilderness North, Wilderness South, Highway One, and Palomarin. The same factors as described above would influence the degree of damage cultural resources might sustain, and the same mitigation measures would be applied to minimize this damage.

Prescribed Fire

Same as Alternative A, except 500 additional acres/year would be treated by prescribed fire. Therefore, beneficial effects to cultural landscapes and historic structures would be greater. Regarding archeological resources, the potential for a minor, short-term, adverse effect from inadvertently burning an archeological site would be greater. The potential for these impacts has increased because prescribed fire would be used in Inverness Ridge, Wilderness North, Wilderness South, and Palomarin FMUs in addition to the four FMUs (Estero, Limantour Road, Highway One, and Bolinas Ridge) in Alternative A. Palomarin FMU probably has the greatest potential for additional archeological sites to be inadvertently impacted.

Unplanned Ignitions, Wildfire, and Suppression

The chance of an unplanned ignition or wildfire occurring in this alternative is very close to the same as in Alternative A, and the long-term, major, adverse impacts to historic structures or cultural landscapes from direct effects of the fire, and to archeological resources from suppression or mop-up would be the same as well.

Mechanical Treatments

The same types of impacts as described in Alternative A, both beneficial and adverse, would occur as a result of mechanical treatments. However, an additional 500 acres/year would be treated. Although the benefits to cultural landscapes and historic structures would be greater than in Alternative A, they would still be considered short-term and moderate. Also, although impacts to subsurface archeological resources from operations associated with mechanical treatment would potentially cover a wider area than in Alternative A, they would remain minor and short-term because of the implementation of the mitigation measures described above. However, the potential for these impacts has increased because mechanical treatment would be used in Tomales Point, Wilderness North, Wilderness South, and Palomarin FMUs in addition to the four FMUs (Estero, Limantour Road, and Highway One) in Alternative A.

Fire Information/Education

No differences compared to Alternative A in the benefits to fire education are anticipated from implementing Alternative B.

Fire Cache/Park Headquarters Relocation, and Construction

No differences compared to Alternative A in the impacts of constructing and operating a fire cache are anticipated from implementing Alternative B.

Fire Effects and Fuel Management Research

No additional benefits from conducting research identified as part of this alternative are expected compared to Alternative A.

Cumulative Impacts

No additional cumulative impacts beyond those described above for Alternative A are expected.

Conclusions

Alternative B would have short-term, moderate, beneficial effects to historic buildings by reducing fuels around these structures, both through prescribed burns and mechanical treatment. These benefits would be greater than in Alternative A, but would remain in the moderate category. Moderate long-term benefits similar but greater than in Alternative A to cultural landscapes from the restoration or maintenance of them through prescribed fire or mechanical treatments are also likely. As in Alternative A, mitigation measures would keep impacts to archeological resources from pre-treatment for prescribed burns, or mechanical thinning activities from becoming more than short-term and minor. However, the potential for these impacts is greater because both mechanical and prescribed fire programs are treating more FMUs.

A large-scale uncontrolled wildfire could have long-term, major, adverse effects to historic buildings and cultural landscapes. Suppression and/or mop-up of such a fire could have long-term, major, adverse effects to archeological resources. Suppression activities associated with more average wildfires could also have negligible to major impacts to cultural resources.

No adverse or beneficial effects are anticipated with the construction of the new fire cache or implementing research activities on historic structures, archeological sites, or cultural landscapes.

The alternative would not result in long-term impairment to cultural resources.

Alternative C

Analysis

This alternative would allow prescribed burning of 2000 acres/year in 10 FMUs including Tomales Point, Estero, Headlands, Inverness Ridge, Limantour Road, Wilderness North, Wilderness South, Highway One, Bolinas Ridge, and Palomarin and mechanical treatment in all except the Point Reyes Headlands for a total of 1,500 acres/year.

Prescribed Fire

Same as Alternative A, except 1,500 additional acres/year would be treated by prescribed fire for a total of 2000 acres/year. Therefore, beneficial effects to cultural landscapes and historic structures would be greater than A. Regarding archeological resources, the potential for a short-term adverse effect from inadvertently burning an archeological site would be greater than Alternative A or B. The impacts are moderate because they could affect a moderate percentage of significant resources; however, because of mitigation measures these resources still have low vulnerability. In addition, this alternative, above the eight treated in Alternative B) treats the Headlands and Tomales Point FMUs that have high potential for archeological resources.

Unplanned Ignitions, Wildfire, and Suppression

The chance of an unplanned ignition or wildfire occurring in this alternative is very close to the same as in Alternative A, and the long-term major adverse impacts to historic structures or cultural landscapes from direct effects of the fire, and to archeological resources from suppression or mop-up would be the same as well.

Mechanical Treatments

Same as Alternative A, except 1000 additional acres/year would be treated by mechanical means for a total of 1500 acres/year. Therefore, beneficial effects to cultural landscapes and historic structures would be greater than Alternative A and B. Regarding archeological resources, the potential for a short-term, adverse, effect from inadvertently mechanically treating an archeological site would be greater than Alternative A or B. The impacts are moderate because they could affect a moderate percentage of significant resources; however, because of mitigation measures these resources still have low vulnerability. In addition, this alternative, above the seven treated in Alternative B) treats the Inverness Ridge, Bolinas Ridge and Tomales Point FMUs that could have archeological resources that have not be surveyed or located.

Fire Information/Education

No differences compared to Alternative A in the benefits to fire education are anticipated from implementing Alternative C.

Fire Cache/Park Headquarters Relocation, and Construction

No differences compared to Alternative A in the impacts of constructing and operating a fire cache are anticipated from implementing Alternative C.

Fire Effects and Fuel Management Research

No additional benefits from conducting research identified as part of this alternative are expected compared to Alternative A.

Cumulative Impacts

No additional cumulative impacts beyond those described above for Alternative A are expected.

Conclusion

Actions included in Alternative C include prescribed burn projects encompassing up to 2000 acres/year, mechanical treatment projects covering up to 1500 acres/year and a suppression program. The fire cache would be located at park headquarter at Bear Valley and education and research are similar to Alternative A and B. Beneficial impacts of this alternative include the ability to pre-plan for increased prescribed burns and mechanical treatments. On the other hand, additional prescribed burning means that those cultural resources vulnerable to direct fire effects could be adversely impacted in situations where adequate pre-burn survey and/or mitigation could not be employed. Among the beneficial impacts of this alternative are the ability to pre-plan for prescribed burns, mechanical treatments, defensible space, and road maintenance.

This alternative would result in short-term, moderate, beneficial effects from prescribed fire and mechanical thinning to historic buildings by reducing fuels around these structures. The effects would be greater than Alternative A and B. Archeological sites would experience short-term, moderate, adverse effects if an area were inadvertently impacted. The potential for these impacts to archeological resources is greater than Alternative A and B because more acres and FMUs are being treated. Cultural landscapes would have long-term, moderate, beneficial effects because historic landscapes such as grasslands could be perpetuated over time. The effects would be greater than Alternative A and B.

No adverse or beneficial effects are anticipated with the construction of the new fire cache on historic structures, archeological sites, or cultural landscapes.

Suppression of average sized wildfires could have negligible to major long-term, major, adverse effects to historic buildings or archeological sites. A major wildfire could have major long-term impacts from the loss of historic structures during burning, or archeological sites during suppression and mop-up. Cultural landscapes could experience long-term, major, adverse effects because historic landscapes could be dramatically changed by uncontrolled wildfire.

The alternative would not result in long-term impairment to cultural resources.

IMPACTS TO VISITOR USE AND THE VISITOR EXPERIENCE

Alternative A

Analysis

This alternative continues the current fire management program treating 500 acres by prescribed fire and 500 acres with mechanical means. There would continue to be visual and visitor experience impacts from fuel reduction projects underway, prescribed burns that are conducted annually in the spring and fall, and unplanned suppression activities. Two FMUs - Limantour and Highway 1 have areas within designated wilderness.

Prescribed Fire

Prescribed fire can be used as a tool to maintain visual quality and enhance the visitor experience, such as in maintenance of view sheds and cultural landscapes, and it can also have effects that would be considered potentially adverse to the visitor. Under Alternative A, prescribed fire would continue to be used infrequently as a tool for maintaining open scenic views. This acreage treated in three FMUs - Limantour, Highway One, and Bolinas Ridge would potentially increase scenic vistas from trails and major roadways. In this case, effects of prescribed burning on visual resources would be generally beneficial and long-term, but minor, because of the limited number of acres treated.

Some visitors would see the local effects of burning as adverse, but public acceptance of the prescribed fire program has increased to the point that this view would be atypical. For those individuals that are adversely impacted by burned areas, visual impacts such as charred vegetation, blackened earth, or fire lines would be minor because burned areas become green and revegetated with a few months (often by the next winter).

Some visitors would also be impacted by noise from fire management actions, smoke, or the closure of an area (usually less than 200 acres and for one or two days) for a prescribed fire. Sources of noise during prescribed burns may include the operation of fire engines or other heavy equipment, which would move along roads and burn boundaries. A diesel truck traveling at 40 miles per hour at 50 feet can have sound levels of 80 dB (16 times as loud as reference loudness). Noise would be generated for less than 20 days each year on an average to complete projects.

Effects of closures on visitor activities, including hiking, nature study, and scenic touring, would generally be limited to small-scale and temporary restrictions. Visitors would remain able to recreate outside of the prescribed fire project boundary, and very few people would be unable to partake in their chosen activity, although some may need to experience them in another part of the park.

Smoke would affect a wider area, and thus more visitors, than closures and restrictions. However, because prescribed fires would be ignited only under certain atmospheric conditions, the effects of concentrated smoke would generally be localized.

In addition, some visitors expecting a wilderness experience may be adversely impacted from smoke, noise and the sight of a burned area; however, this impact would be short-term and minor.

Overall, effects on the visitor experience from activities associated with prescribed burning in this alternative would be adverse, short-term, and minor.

Unplanned Ignitions, Wildfire, and Suppression

Wildland fires would continue to burn approximately 30 acres per year on average, mostly along major roadways. To some, the effect of managed wildland fire on scenic resources would be seen as adverse. Other visitors would see the effects as beneficial and natural. Fire in plant communities that are within their natural range of variability rarely result in extreme events with major effects on visual or scenic quality. The typical effects of fire include blackened bark, cat faces on some trees, opening of the understory, cleaning (through burning) of the litter and duff layer, and the scorching of some trees, resulting in scattered kill and opening of the canopy. It is likely that some park users would see these as non-natural effects and they would consider them adverse visual impacts: however, the impact would be short-term and minor because of the small number of localized acres suppressed each year and the quick growth of new vegetation.

Holding Actions (water and retardant drops, helispots, and spike camps)

These actions have the potential to have short-term effects on visual resources, in the form of evidence of helispots and spike camps. These effects would be local in scale and probably not encountered by most visitors. Effects on visual quality and visitors would be adverse, short-term, and minor.

During wildland fire incidents, helicopters would be used as needed for reconnaissance, monitoring, and moving people and supplies. At least one flight per day would normally be flown over fires, many of which would be in wilderness. If the fire grows, the reconnaissance area and flight duration would increase as well. Helicopters 100 feet from a person would be as loud as 100 dB, a sound that would be uncomfortably loud. In relative terms, this would be 128 times as loud as an urban, daytime ambient noise level of 40 dB. Should it occur, the effect on visitors in the vicinity would be adverse, but since it would be localized and temporary, would remain minor. In addition, areas may be closed for short periods (less than five days) for unplanned wildfire suppression activities, but the adverse impacts to visitors would be minor and short-term.

Mechanical Treatment

Mowing, hand cutting, chipping and pile burning actions could adversely affect visitors in both the immediate area during treatment, and those who pass through or view the area shortly after treatment is completed. Mowing and hand cutting is currently used as a tool to reduce fuels around building and along Highway One FMU and in the Estero FMU. Noise from equipment, air emissions and the presence of human activity in natural areas are examples of short-term adverse impacts to visitors. Chainsaws in close proximity would be the loudest typical equipment, with sounds as loud as 100 dB. This noise, especially in a park setting, would be an adverse impact on the park visitor experience, but would be short-term and minor. Because some areas would be closed during mechanic treatments, the visitor would be impacted only a few days (less than 20 per year), and the impacts would be minor because they would be extremely localized.

Pile burning has two potential effects on visual quality. First, piles of stacked fuels would be visible, potentially within major scenic views. Second, piles once burned would leave a pattern of burned area that would appear unnatural. Both effects would be adverse, short-term, and minor because they would be small areas (less than five acres) that are burned and the piles would be burned and have new vegetation by the next winter.

The area treated would also appear different; this may be perceived as an adverse impact as well, although with public information and education, some visitors would view treatment as a beneficial impact. In either case, the impact would be minor, because vegetation would return quickly and the visual change would be localized.

In addition, some visitors expecting a wilderness experience may be adversely impacted from noise and the sight of a mechanically treated area; however, this impact would be short-term and minor.

Fire Information/Education

The PRNS has staff to assist with fire education to provide information to the visiting public and community. Providing information to the public to increase understanding of the objectives of the fire program would be beneficial, minor and long-term.

Fire Cache/Park Headquarters Relocation, and Construction

Relocation of the fire cache and construction in the present park headquarters compound would not have any adverse impacts to viewsheds. The construction of a new building would be completed with a site design that incorporates an appreciation of the green space in the headquarters area and the site is not accessible to the public. The relocation of the fire cache would be completed in an area formerly occupied by a trailer. Although some temporary adverse impacts associated with noise of construction are expected, this would be no more than minor and temporary.

Fire Effects and Fuel Management Research

The PRNS has staff to assist with fire research and document the effects of mechanical and prescribed fire treatments and provide this information to the visiting public and community. No impacts to visual resource would occur from fire research; however, providing information to the public to increase understanding of the objectives of the fire program would be beneficial, minor, and long-term.

Cumulative Impacts

There have been very few actions taken inside or outside the park in the past to affect the visitor experience. Past fire management and fuels treatment activities have resulted in burned areas, cut stumps, evidence of holding lines, burned area rehabilitation work, and others that some may view as adverse. Some of these impacts are potentially visible from highways entering the park such as Sir Francis Drake and Highway One, if passersby knew where to look for them.

Based on an analysis of the list of projects in Appendix C, the cumulative impacts of all the projects listed with this proposed action would have a minor adverse effect on park visual quality and the visitor experience. The projects listed do not have long-term impacts to visual quality or experience. However, a large-scale wildfire such as the Vision Fire would have a major adverse effect on visual quality and the visitor experience.

Under all alternatives, large, high-intensity, high severity fires would continue to occur infrequently in the park until the majority of the park is restored to its natural function. Because fires have been, and would continue to be, suppressed, fuels build up and the plant community structure changes. It is unlikely that this situation would change markedly during the life of this revised Fire Management Plan. If these conditions resulted in a large, high severity fire, there may be both short and long-term major adverse impacts.

During catastrophic fires, large numbers of firefighting personnel and equipment would be deployed to control the fire, as needed. Helicopters, chain saws, and other sources of sometimes very loud noise could be used over very large areas for several days or weeks. During suppression actions that are brought about because of large, high severity fires, noise effects would be adverse, short-term, and major.

Over the longer term, scenic quality and recreational opportunities, including sightseeing, hiking in natural areas, and viewing wildlife, may experience large-scale changes that last for many years, resulting in major long-term adverse impacts under all alternatives.

Conclusion

Prescribed burning would have minor positive effects by opening and restoring scenic vistas, but to some visitors the short-term blackening of vegetation from prescribed fires may be a minor adverse effect. Smoke and closures would also have temporary, minor, adverse impacts on visitors.

Mechanical treatment may adversely affect nearby visitors through noise. Changes in the treated area from mowing or hand cutting would be adverse for some visitors, but beneficial for others. Pile burning may also cause localized changes that some visitors find to be negative and other positive. Overall, impacts from mechanical treatment would be short-term and minor, regardless of whether they are adverse or beneficial.

Actions to suppression wildfire have the potential to have short-term effects on visual resources, in the form of evidence of helispots and spike camps. These effects would be local in scale and probably not encountered by most visitors. Effects would be adverse, short-term, and minor.

Providing information to the public to increase understanding of the objectives of the fire program would be indirectly beneficial, minor, and long-term.

The relocation of the fire cache would have short-term adverse impacts to visitors from noise and dust associated with construction.

While construction projects or past fire management activities would have no more than minor short-term impacts to visitors, a large-scale wildfire could result in major adverse impacts to recreational activities or scenic quality for several years. Eventually, these resources would recover, and no permanent loss of their integrity, e.g., impairment, would occur.

Alternative B

Analysis

The impacts of this alternative on scenic resources would be similar to that of the No Action (Alternative A), except in the following areas:

Prescribed Fire

While Alternative B has no specific intent to use prescribed burning to improve scenic vistas or other components of the visitor experience, it would result in twice the acreage treated with prescribed fire as in Alternative A. It would also treat in four FMUs - Inverness Ridge, Wilderness North and South, and Palomarin - where treatment to reduce fuels could have side benefits to visitors by clearing scenic views from forest fuels that have become overstocked and degraded over the past century. Because these benefits would only occur in a small portion of the up to 1,000 acres treated each year, the potential to enhance visual resources would be only a minor benefit.

As noted above, these same changes could also be interpreted by some visitors, including backcountry visitors in this alternative, as negative. However, public acceptance of the prescribed fire program has increased to the point that changes in vegetation resulting from prescribed burning would not be seen as adverse by most visitors; education of visitors would continue this acceptance and perception of prescribed fire as a benefit. Even so, visual impacts such as charred vegetation, blackened earth and fire lines would be adverse, short-term, and minor to some park users.

Visitors would experience minor, short-term, adverse impacts from noise and smoke, and from closures, total up to 30 days in this alternative.

A detectable benefit to scenic or recreational resources by reducing the risk of destruction through catastrophic fire is likely with this alternative as well. Prescribed burning would be lower intensity than wildfire, resulting is fewer noticeable changes in scenery and the ultimate protection of visual resources. Over time, the benefit would be minor.

Unplanned Ignitions, Wildfire, and Suppression

No changes in impacts from unplanned ignitions, average annual wildfires, or their suppression from those described in Alternative A are expected.

Mechanical Treatments

This alternative increases mechanical treatment to 1000 acres, including highly scenic FMUs (Wilderness North and South, Tomales Point, and Palomarin). Treatment and closures would last for about 30 days each year. Noise from mowing, hand-cutting and chipping equipment, air emissions, and the presence of human activity in natural areas could have adverse, localized, short-term impacts on visitors. Because some areas would be closed during mechanic treatments, visitors would be affected for only a few days (less than 30 per year) and impacts would be minor.

The same effects of pile burning described above would occur under this alternative over a wider area of the park. Because the burned areas would quickly revegetation, the impact would be short-term and minor.

The area treated would also appear different; this may be perceived as an adverse impact as well, although with public information and education, some visitors would view treatment as a beneficial impact. In either case, the impact would be minor, because vegetation would return quickly and the visual change would be localized.

Fire Information/Education

No changes in impacts from those described for Alternative A would be expected.

Fire Cache/Park Headquarters Relocation, and Construction

No changes in impacts from those described for Alternative A would be expected.

Fire Effects and Fuel Management Research

No changes in impacts from those described for Alternative A would be expected.

Cumulative Impacts

No changes in impacts from those described for Alternative A would be expected.

Conclusion

Prescribed burning would have minor positive effects by opening and restoring scenic vistas, but to some visitors the short-term blackening of vegetation from prescribed fires may be a minor adverse effect. Smoke and closures (up to 30 days) would also have temporary minor adverse impacts on visitors.

Mechanical treatment may adversely affect nearby visitors through noise (closures up to 30 days of small areas). Changes in the treated area from mowing or hand cutting would be adverse for some visitors, but beneficial for others. Pile burning may also cause localized changes that some visitors find to be negative and other positive. Overall, impacts from mechanical treatment would be short-term and minor, regardless of whether they are adverse or beneficial.

Actions to suppression wildfire have the potential to have short-term effects on visual resources, in the form of evidence of helispots and spike camps. These effects would be local in scale and probably not encountered by most visitors. Effects would be adverse, short-term, and minor.

Providing information to the public to increase understanding of the objectives of the fire program would be indirectly beneficial, minor, and long-term.

The relocation of the fire cache would have short-term adverse impacts to visitors from noise and dust associated with construction.

While construction projects or past fire management activities would have no more than minor short-term impacts to visitors, a large-scale wildfire could result in major adverse impacts to recreational activities or scenic quality for several years. Eventually, these resources would recover, and no permanent loss of their integrity, e.g., impairment, would occur.

Alternative C

Analysis

The impacts of this alternative on scenic resources would be similar to that of the No Action Alternative, except in the following areas:

Prescribed Fire

Under this alternative, prescribed fire would be significantly increased (2000 acres) and could be used as a major tool for restoring and maintaining scenic resources. Although PRNS does not have any specific plans in place to address scenic vistas, there are areas (Limantour, Highway One, Wilderness North and South FMU, Palomarin FMU) in which prescribed fire could be employed to improve aesthetics and vistas. This acreage would only be a small portion of the 2,000 acres per year treated on average for resource and hazardous fuel reduction, but the actions would clear scenic views of forests that have become overstocked and degraded over the past century. Prescribed fire would be used in all ten FMUs and have the potential to change the landscape character of an area and therefore has the potential to affect more visitors in the park. For visitors who perceive these changes and/or the use of prescribed fire as a tool to return systems to natural conditions, moderate benefits are possible in this alternative. For those who believe the changes are negative, moderate adverse impacts may result.

Short-term adverse impacts from blackened earth, charred vegetation, fire lines, smoke, and closures for up to 50 days could be moderate because of the larger number of acres treated.

A larger benefit to scenic or recreational resources by reducing the risk of destruction through catastrophic fire than in Alternatives A or B would result from implementing this alternative. Prescribed burning would be lower intensity than wildfire, resulting is fewer noticeable changes in scenery and the ultimate protection of visual resources. Over time, the benefit could be moderate.

Unplanned Ignitions, Wildfire, and Suppression

No changes in impacts from those described for Alternative A would be expected.

Mechanical Treatments

This alternative increases mechanical treatment to 1500 acres, including several highly scenic FMUs (Wilderness North and South, Tomales Point, and Palomarin). Treatment and closures would last for about 50 days each year. Noise from mowing, hand-cutting and chipping equipment, air emissions, and the presence of human activity in natural areas could have adverse, localized, short-term impacts on visitors. The combination of these short-term impacts from noise and closures may become quite noticeable and moderately adverse to visitors.

Pile burning would occur on cut fire lines as the primary method of brush disposal but on a much larger scale than in Alternative A and Alternative B. The piles of stacked fuels would be visible in the immediate area of work, and potentially within some scenic views. When burned, the piles would leave a pattern of burned area that would not appear natural. As in Alternative A and B, impacts would be adverse, short-term, and moderate.

The area treated would also appear different; this may be perceived as an adverse impact as well, although with public information and education, some visitors would view treatment as a beneficial impact. In either case, the impact would be minor to moderate, and vegetation would return quickly.

Fire Information/Education

No changes in impacts from those described for Alternative A would be expected.

Fire Cache/Park Headquarters Relocation, and Construction

No changes in impacts from those described for Alternative A would be expected.

Fire Effects and Fuel Management Research

No changes in impacts from those described for Alternative A would be expected.

Cumulative Impacts

No changes in impacts from those described for Alternative A would be expected.

Conclusion

Prescribed burning would have minor positive effects by opening and restoring scenic vistas, but to some visitors the short-term blackening of vegetation from prescribed fires may be a moderate adverse effect. Smoke and small closures of areas (up to 50 days) would also have temporary moderate adverse impacts on visitors.

Mechanical treatment may adversely affect nearby visitors through noise and small closures of areas up to 50 days. Changes in the treated area from mowing or hand cutting would be adverse for some visitors, but beneficial for others. Pile burning may also cause localized changes that some visitors find to be negative and other positive. Overall, impacts from mechanical treatment would be short-term and moderate, regardless of whether they are adverse or beneficial.

Actions to suppression wildfire have the potential to have short-term effects on visual resources, in the form of evidence of helispots and spike camps. These effects would be local in scale and probably not encountered by most visitors. Effects would be adverse, short-term, and minor.

Providing information to the public to increase understanding of the objectives of the fire program would be indirectly beneficial, minor, and long-term.

The relocation of the fire cache would have short-term adverse impacts to visitors from noise and dust associated with construction.

While construction projects or past fire management activities would have no more than minor short-term impacts to visitors, a large-scale wildfire could result in major adverse impacts to recreational activities or scenic quality for several years. Eventually, these resources would recover, and no permanent loss of their integrity, e.g., impairment, would occur.

IMPACT TO PARK OPERATIONS

Alternative A

The park currently has about 115 full-time employees (FTEs) and an operating budget of approximately $4.9 million, excluding the fire budget. In addition, the park receives annually about $2.6 million in one-time funding from fees, and from special NPS funds for natural resource, education, cultural resource, and maintenance projects (maintenance projects include repair and rehabilitation funding for buildings).

Fire funding for operations is approximately $770,000 annually for wildfire suppression, mechanical treatments, and prescribed fire. For the last three years, Point Reyes and GGNRA have received an additional $700,000 annually for Wildland Urban Interface (WUI) projects. Staffing for all aspects for fire management is approximately 13 FTEs (Wong, 2003).

The total operations budget for Point Reyes is $5.67 million.

Analysis

Prescribed Fire

Under this alternative, 500 acres/year at FMUs Estero, Limantour Road, Highway One, and Bolinas Ridge would be treated with prescribed fire. Only actions described in the section Actions Common to All Alternatives, including road maintenance and brushing around buildings, would occur in the other FMUs. Because this is a continuation of existing practices, no additional funding or FTEs would be needed. Because the FMUs on Inverness Ridge, Palomarin, Wilderness North and South would not be treated, facilities at Five Brooks (horse campground, horse stables), housing along Inverness Ridge, and park facilities (Point Reyes Bird Observatory

Visitor Center and Commonweal housing) at Palomarin would be more susceptible to a large-scale fire. The reduction of hazardous fuels around park facilities in these FMUs would reduce the risk of a catastrophic fire and the potential for loss of a structure.

Unplanned Ignitions, Wildfire, and Suppression

The park relies heavily on Marin County Fire Department for structural fire and wildland fire protection. The NPS is considered support and back up for large-scale events. For the most part, this arrangement has been highly effective in controlling unplanned ignitions and wildfires. As noted in other sections of the EIS, on average the park has only three smaller unplanned ignitions (of about 10 acres) each year. Because the No Action alternative would continue this arrangement and level of effort, no additional funding or FTE is needed. Therefore no beneficial or adverse impacts are anticipated.

Mechanical Treatments

Under this alternative, 500 acres/year at FMUs Estero, Limantour Road, Highway One, and Bolinas Ridge would be treated by mechanical means. Actions in the other FMUs would be those described in the Actions Common to All Alternatives section of the EIS, including road maintenance and creating defensible space around structures. Because this is a continuation of existing practices, no additional funding or FTEs would be needed. Therefore no beneficial or adverse impacts are anticipated. Because the FMUs on Inverness Ridge, Palomarin, Wilderness North and South would not be treated, facilities at Five Brooks (horse campground, horse stables), housing along Inverness Ridge, and park facilities (Point Reyes Bird Observatory Visitor Center and Commonweal housing) at Palomarin would be more susceptible to a large-scale fire. The reduction of hazardous fuels around park facilities in these FMUs would reduce the risk of a catastrophic fire and the potential for loss of structures.

Fire Information/Education

The NPS has one staff and additional interns to assist with fire education. No change in this staffing level would occur under the No Action alternative.

Fire Cache/Park Headquarters Relocation, and Construction

The construction of a fire cache at Bear Valley would have a one-time cost of approximately $500,000. This is a one-time negligible adverse impact to the park's budget. Existing staff would be relocated to this facility. No additional operating costs are necessary. The park would receive operational benefits by having a facility and fire staff close to park headquarters. Having a fire cache at park headquarters would have beneficial effects on park operations; it would allow for more efficient use of staff time (At present, staff travel to and from Hagmaier Fire Cache; approximately 7 miles from Bear Valley.) and the fire program would be closer to the major park assets such as the Bear Valley Visitor Center and major maintenance facilities. In addition, there would be long-term minor beneficial effects by having a more energy efficient building.

Fire Effects and Fuel Management Research

No new staffing or funding is necessary; therefore no beneficial or adverse impacts would be anticipated.

Cumulative Impacts

Based on an analysis of the list of projects in Appendix C, the cumulative impacts of all the projects listed with this proposed action would have a negligible adverse effect on park operations and management. The projects listed do not require additional operating funds or staff except for minor adjustments to the park's operating budget. However, a large-scale wildfire such as the Vision Fire would have a short-term adverse major effect on park operations and management. The cost to suppress the Vision Fire is estimated to have been $6.4 million.

Conclusion

Because funding and staffing levels would remain the same for all aspects of the fire management program, no positive or adverse impacts to either are expected from No Action. The one time funding of a new fire cache would have a short-term negligible adverse impact to the park's budget, but would have long-term minor benefits in terms of fire management operations by creating new efficiencies.

The cumulative impacts of all the projects listed with this proposed action (except large-scale wildfire) would have a negligible adverse effect on park operations and management. Suppression of a large-scale wildfire would a short-term adverse major effect on park operations, management, and budget.

The alternative would not result in long-term impairment to park operations and management.

Alternative B

Alternative B would allow prescribed burning of 1000 acres/year in 8 FMUs including Estero, Inverness Ridge, Limantour Road, Wilderness North, Wilderness South, Highway One, Bolinas Ridge, and Palomarin.

Analysis

Prescribed Fire

To accomplish the level of treatment described above, $105,000 in additional funding and 1.5 FTEs would be needed (Wong, 2003). This is a 1.9% increase in funding compared to No Action, and a minor adverse impact on park operations and management. Because the FMUs on Inverness Ridge, Palomarin, Wilderness North and South are treated (above Alternative A), facilities at Five Brooks (horse campground, horse stables), housing along Inverness Ridge, and park facilities (Point Reyes Bird Observatory Visitor Center and Commonweal housing) at Palomarin would be less susceptible to a large-scale fire. The reduction of hazardous fuels around park facilities in these FMUs would reduce the risk of a catastrophic fire and the potential for loss of a structure.

Unplanned Ignitions, Wildfire, and Suppression

As noted in Alternative A, the park relies heavily on Marin County Fire Department for structural fire and wildland fire protection and the NPS is considered support and back-up for large-scale events. The arrangement has worked well over all to suppress unplanned ignitions and keep wildfires to about 30 acres or less per year on average. Therefore no changes are anticipated and no beneficial or adverse impacts relative to No Action would occur.

Mechanical Treatments

Under this alternative, 1000 acres/year at FMUs Tomales Point, Estero, Limantour Road, Highway One, Wilderness North and South, and Palomarin would be treated by mechanical means. To accomplish this level of treatment, $105,000 in additional funding and 1.5 FTEs would be needed (Wong, 2003). This is a 1.9% increase in operation funding and a minor adverse impact on park operations and management. Because the FMUs on Tomales Point, Palomarin, Wilderness North and South would be treated by mechanical means (above Alternative A), facilities at Five Brooks (horse campground, horse stables), and park facilities (Point Reyes Bird Observatory Visitor Center and Commonweal housing) at Palomarin would be treated to be less susceptible to a large-scale fire. The reduction of hazardous fuels around park facilities in these FMUs would reduce the risk of a catastrophic fire and the potential for loss of structures.

Fire Information/Education

No changes in staffing or funding from those in No Action are anticipated.

Fire Cache/Park Headquarters Relocation, and Construction

As in Alternative A, the construction of a fire cache at Bear Valley would have a one-time cost of approximately $500,000. Existing staff would be located to this facility. No additional operating costs are necessary and some beneficial impacts to park operations would occur as described in Alternative A.

Fire Effects and Fuel Management Research

No new staffing or funding is necessary; therefore no beneficial or adverse impacts are anticipated.

Cumulative Impacts

No cumulative impacts except those described above for Alternative A would occur.

Conclusions

Small increases in budget in Alternative B to conduct additional prescribed burning and thinning would have minor adverse impacts to park operations and management compared to Alternative A. This alternative requires a $211,000 in annual operating funds, a 3.8% increase to overall park funding. The one time funding of a new fire cache would have a short-term, negligible, adverse impact to the park's budget, but would have long-term minor benefits in terms of fire management operations by creating new efficiencies.

The cumulative impacts of all the projects listed with this proposed action (except large-scale wildfire) would have a negligible adverse effect on park operations and management. Suppression of a large-scale wildfire would a short-term, adverse, major effect on park operations, management, and budget.

The alternative would not result in long-term impairment to park operations and management.

Alternative C

Alternative C would allow prescribed burning of 2000 acres/year in 10 FMUs including Tomales Point, Estero, Headlands, Inverness Ridge, Limantour Road, Wilderness North, Wilderness South, Highway One, Bolinas Ridge, and Palomarin and mechanical treatment in all except the Point Reyes Headlands for a total of 1,500 acres/year.

Analysis

Prescribed Fire

To accomplish the prescribed burning of 2000 acres/year in the FMUs described above, $227,000 in funding (3.9% increase) and 4.0 additional FTEs would be needed (Wong, 2003); therefore, there would be minor adverse impacts on park operations and management. Because the FMUs are treated, facilities at Five Brooks (horse campground, horse stables), housing along Inverness Ridge, and park facilities (Point Reyes Bird Observatory Visitor Center and Commonweal housing) at Palomarin would be less susceptible to a large-scale fire. In addition, treatment at Tomales Point would provide some protection to facilities at Pierce Point Ranch and treatments at the Headlands would provide some fire protection for the Lifeboat Station Complex. The reduction of hazardous fuels around park facilities in these FMUs would reduce the risk of a catastrophic fire and the potential for loss of a structure.

Unplanned Ignitions, Wildfire, and Suppression

As noted in Alternative A, the park relies heavily on Marin County Fire Department for structural fire and wildland fire protection and the NPS is considered support and back-up for large-scale events. The arrangement has worked well over all to suppress unplanned ignitions and keep wildfires to about 30 acres or less per year on average. Therefore no changes are anticipated and no beneficial or adverse impacts relative to No Action would occur.

Mechanical Treatments

Under this alternative, 1,500 acres/year at FMUs Tomales Point, Estero, Limantour Road, Highway One, Wilderness North and South, Highway One, Palomarin, and Bolinas Ridge would be treated by mechanical means. To accomplish this level of treatment, $113,000 in additional funding (1.9 % increase) and 1.0 FTEs would be needed (Wong, 2003); therefore, there would be minor adverse impacts on park operations and management. Because all the FMUs would be treated by mechanical means except the Headlands, facilities at Five Brooks (horse campground, horse stables), housing along Inverness Ridge, and park facilities (Point Reyes Bird Observatory Visitor Center and Commonweal housing) at Palomarin would be treated to be less susceptible to a large-scale fire. By treating Bolinas Ridge, the ability of the park to stop a fire from traveling from the east or west would be enhanced; therefore, facilities in Olema Valley would have greater protection. The reduction of hazardous fuels around park facilities in the FMUs listed would reduce the risk of a catastrophic fire and the potential for loss of structures.

Fire Information/Education

No changes in staffing or funding from those in No Action are anticipated.

Fire Cache/Park Headquarters Relocation, and Construction

As in Alternative A, the construction of a fire cache at Bear Valley would have a one-time cost of approximately $500,000. Existing staff would be located to this facility. No additional operating costs are necessary and beneficial impacts to park operations are anticipated as described in Alternative A.

Fire Effects and Fuel Management Research

No new staffing or funding is necessary; therefore no beneficial or adverse impacts are anticipated. However, because additional research is proposed, one-time research projects would need funding. Therefore, there would be a minor impact to the park's budget.

Cumulative Impacts

No cumulative impacts except those described above for Alternative A would occur.

Conclusions

An overall 5.9% increase in budget and additional 5 FTEs in staffing in Alternative C to conduct additional prescribed burning and thinning would have minor adverse impacts to park operations and management compared to Alternative A. These increases would be larger than in Alternative B. However, the beneficial impacts to providing fire protection for park facilities are greater than Alternative A and B. The one time funding of a new fire cache would have a short-term, negligible, adverse impact to the park's budget, but would have long-term minor benefits in terms of fire management operations by creating new efficiencies.

The cumulative impacts of all the projects listed with this proposed action (except large-scale wildfire) would have a negligible adverse effect on park operations and management. Suppression of a large-scale wildfire would a short-term adverse major effect on park operations, management, and budget.

The alternative would not result in long-term impairment to park operations and management.

IMPACTS TO HUMAN HEALTH AND SAFETY

Alternative A

Human health may be affected by prescribed burning and wildland fire through the inhalation of smoke. During a prescribed burn, visitors would remain outside the area through the use of temporary trail closures, signing, public information about the fire, and other temporary closures of areas and facilities. In the case of an "average" wildland fire (e.g., the park on average experiences fires in fewer than 30 acres), visitors or community members may require evacuation. In either case, they would not be exposed to the fire itself and safety risks would be minimized. However, firefighting personnel would be much closer to either prescribed burns or wildland fires, and so may be subject to increased risk to their safety.

All individual wildland fire use and prescribed fire projects would be managed under the same conditions and constraints under all alternatives. Each project would be implemented only with the concurrence of the Bay Area Regional Air Quality Control District, and managed to maintain smoke emissions in communities below the legal thresholds as defined by the State of California and the Environmental Protection Agency. Because of these restrictions, alternatives with more acres burned under prescription, and therefore where timing, placement and conditions under which they burn, would be more successful at minimizing smoke impacts over the long-term.

Analysis

Prescribed Fire

The principal effect of FMP activities on public health is generation of smoke, especially particulate matter, from prescribed fires and unintended wildland fire. Particulate matter, found in the air-liquid droplets and small solid particles of minerals and soot can penetrate deep into the lungs because it is small. In smoke, roughly 80% of the particulate matter is smaller than 2.5 micrometers in diameter. Smoke impacts are not related only to acreage burned, but to vegetation type, fuel loading and weather conditions, among other factors. For example, grassland fires produce much less smoke per acre than do forest fuels. Even areas of similar vegetation types in forested areas may have significantly different amounts of emissions due to lower fuel load and smoke production in restored areas compared to areas that have missed several cycles of wildland fire and contain unnaturally heavy fuel loadings.

Healthy adults are not usually at risk from particulate matter; they may experience runny noses and coughing but these symptoms usually subside as the smoke disperses. People with heart or lung diseases, such as congestive heart disease, chronic obstructive pulmonary disease, emphysema, or asthma can be at risk. People with these conditions may find it difficult to breathe, may cough, or feel short of breath after inhaling smoke from a prescribed burn or wildland fire. Children and the elderly are generally more susceptible to the harmful effects of smoke (CARB, 2003).

Most byproducts of wildland and prescribed fire combustion of health concern are concentrated at the fire line, and decrease to negligible levels in very short distances. Local weather patterns affect smoke mixing and movement, especially at night. Generally, the greater distance from the fire, the larger the volume of air available to dilute smoke below levels considered harmful to humans. Despite this apparent relative benefit, fine particulates also travel much greater distances from firelines, making them of most concern to public health.

Firefighters are exposed to the highest health risk from smoke on or near the firelines. The risks are well studied and include inhalation of carbon monoxide, hydrocarbons, and particulates. Standard firefighting practices are employed to minimize firefighter exposure. These practices include: planning the location of firelines to minimize exposure and rotating firefighters out of smoky segments of the fire line at frequent intervals. Firefighter safety may also be at risk, although prescribed burns are well planned and risks are minimal. Sources of risk, in addition to the fire itself, include tree felling, fire line construction, helicopter transport, and handling petroleum products.

Fire management personnel would be exposed to increasingly hazardous conditions at the Seashore over time as fuels continue to accumulate in untreated areas of the parks and the risk of high severity fire grows. Efforts at direct attack or suppression of intense fires can become increasingly difficult the hotter and quicker a fire burns.

Because Alternative A would only result in a maximum of 500 acres burned each year, impacts to fire fighting personnel, visitors and community members from smoke would remain short-term and minor. However, this alternative would do relatively less than the other alternatives to address the continued accumulation of fuels in the park, and the risk of a large and hot wildfire similar to the Vision Fire. Should such a fire burn, both health and safety may be seriously threatened.

Wildland Fire and Suppression

Wildland fires on average burn less than 30 acres at the Seashore each year. Although the location at which these fires may burn is not controlled, they are quickly suppressed and are small. Therefore the smoke impacts from average wildland fires to visitors, community members, or firefighting personnel would be short-term, minor, and localized.

Mechanical Treatment

Up to 500 acres of land would be mechanically thinned, some of it to reduce accumulated fuels. To the extent that the risk of a catastrophic fire is reduced by mechanical treatment, some negligible benefit to long-term safety and human health is possible, as both the risk of injury from the fire itself and to human health from inhaling smoke would be reduced. Mechanical treatment projects in the Limantour, Highway One, and Bolinas Ridge FMUs would also improve safety to responding firefighters by reducing fuels along existing fire roads and creating zones of reduced fuels to impede wildfire spread.

Any potential safety impacts to visitors from equipment use would be eliminated or minimized through posted closures during mechanical treatment.

Public Education and Research/Fire Cache Construction

Public education, fire research, and the building of a fire cache would all have beneficial, long-term impacts on human health and safety. Public education would provide timely information on fire management actions and inform the public about prescribed or wildland burns and closures. Research could help in providing guidance on how to best avoid smoke or danger to residents or fire fighters. Locating a cache closer to other park administrative offices would reduce response time. Together, these offer negligible to minor benefits to human health and safety.

Cumulative Impacts

The projects listed in Appendix C would not have adverse impacts to human health and safety. However, a large-scale wildfire such as the Vision Fire could have a short-term adverse major effect on the health and safety of firefighters, visitors, and local communities.

A large wildfire has the potential to increase the exposure of visitors, employees, and communities to ground level smoke, particularly during late night and morning periods when smoke plumes collapse, descend and concentrate in low-lying areas or canyon bottoms. Wildland fires similar to those in 1999, when numerous wildland fires were burning simultaneously throughout northern California could affect the park and, thus, the health and safety of visitors and park employees for several weeks.

During catastrophic fires, large fire organizations would be employed to control the fire, as needed. When this occurs, a larger amount of equipment, including helicopters and fire engines, would be used to accomplish fire control objectives. Complex fire operations can extend their activities over large areas, sometimes tens of thousands of acres. An increase in the number and extent of suppression fires would cause an increase in the rate of exposure of fire personnel to hazardous conditions - both fire and smoke. This exposure would be unplanned with the potential for a higher rate of injury to firefighters and the public. Efforts at direct attack or suppression of intense fire would also pose a threat to firefighter safety due to the nature of such activities. Additional hazards of fighting wildfires include fire line construction, tree falling, helicopter transport, direct flame exposure, and respiratory problems due to smoke inhalation. To help mitigate impacts, firefighters would be frequently rotated and allowed to rest or sleep when needed, and firelines would be used to minimize exposure. Even with these mitigation measures, exposure to risk from the fire itself and from heavy smoke to firefighter, visitors and community members could be major and adverse during the time the fire is burning.

Conclusion

The actions of this alternative would have direct adverse, short-term, and minor impacts upon the health and safety of both the public and firefighters, except during large, high severity fire events, when the proximity of people to smoke and flame would result in major, short-term, and unavoidable adverse impacts. Alternative A minimizes smoke impacts in the short-term, but offers no more than negligible benefits in addressing the continued accumulation of fuels that is a wildfire risk to adjacent communities.

Public education, fire research, and fire cache construction would provide minor benefits by informing the public of prescribed burns and by reducing response time and increasing response effectiveness.

Alternative B

Analysis

The impacts of this alternative on human health and safety would be similar to that of the No Action (Alternative A), except in the following areas:

Prescribed Fire

Double the acreage burned in Alternative A would be treated with prescribed fire. The same types of impacts identified in Alternative A, e.g., inhalation of smoke and particularly of fine particulates by visitors or community members, and of carbon monoxide, hydrocarbons, and particulates by firefighters, would occur. Because more acreage would be burned, the chances of exposure to visitors, employees and the public would be greater. This would particularly be true of ground level smoke, especially during late night and morning periods when smoke plumes collapse, descend and concentrate in low-lying areas or canyon bottoms.

Firefighters would be exposed to the same type of impacts from fire and smoke as described above over a wider acreage. Fire line construction, tree falling, and firing operations would be conducted in a relatively safe and orderly fashion compared to a wildland burn, and prescribed fires are generally of lower intensity and less threatening than wildfires. However, risks would remain, as they would from handling petroleum products and other tasks associated with preparing for and conducting prescribed burns. Although treated acreage would be doubled, mitigation described above would minimize impacts. Injuries may increase, but the rate of such an increase is not possible to predict with any certainty.

Both public and firefighter exposure to wildfire hazards, including smoke, would be progressively reduced over time because of the reduction in fuels associated with the prescribed burning of up to 1,000 acres. The effect would be minor to moderate and long-term.

Wildland Fire and Suppression

Overall, there is no expected increase in fire-caused injuries to visitors, employees, and the public due to current suppression activities that average 30 acres per year.

Mechanical Treatment

Double the acreage in Alternative A would be mechanically treated in this alternative. Mechanical treatment (expanded to 1000 acres) would occur which has the potential to increase the exposure of visitors, employees, and the public to equipment activity. However, because areas to treated are to be temporarily closed, any increase in direct impacts to human health and safety would be short-term and minor.

Mechanical treatment in the Limantour, Highway One, Inverness Ridge, Wilderness North and South, Bolinas Ridge, and Palomarin FMUs would improve safety to responding firefighters, reduce fuels along existing fire roads and create zones of reduced fuels to impede fire spread.

Public Education, Fire Research, and Fire Cache Construction

No differences beyond those identified in Alternative A would occur.

Under this Alternative, fire personnel would be exposed to additional hazards in their work above Alternative A. The effect would be minor, short-term, but greater than Alternative A.

Cumulative Impacts

No cumulative impacts beyond those described under Alternative A would be expected.

Conclusion

Alternative B would have direct adverse, short-term, and minor impacts upon the health and safety of both the public and firefighters, except during large, high severity fire events, when the proximity of people to smoke and flame would result in major, short-term, and unavoidable adverse impacts.

A minor to moderate long-term benefit to public and park staff health and safety greater than that in Alternative A from the reduction of fuels through both prescribed fire and mechanical thinning and reduction in the risk of catastrophic fire would occur.

Public education, fire research, and fire cache construction would provide minor benefits by informing the public of prescribed burns and by reducing response time and increasing response effectiveness.

Alternative C

Analysis

Prescribed Fire

Up to 2000 acres per year would be treated with prescribed burning in this alternative. The same types of impacts identified in Alternative A, e.g., inhalation of smoke and particularly of fine particulates by visitors or community members, and of carbon monoxide, hydrocarbons, and particulates by firefighters would occur. Because more acreage would be burned, the chances of exposure to visitors, employees and the public would be greater than in either Alternative A or B. This would particularly be true of ground level smoke, especially during late night and morning periods when smoke plumes collapse, descend and concentrate in low-lying areas or canyon bottoms. The public and firefighting personnel may also be at slightly greater risk of prescribed fire burning outside its prescription. If this happens, heavier fuel loads could burn with resulting increases in smoke. In the extreme, the fire itself could be threatening, although preparation and the presence of a crew and firefighting apparatus on site means the extent of an escape would be minimal.

Firefighters would be exposed to the same type of impacts from fire and smoke as described above over a wider acreage. Although treated acreage would be expanded, mitigation described above would minimize impacts. Injuries may increase, but the rate of such an increase is not possible to predict with any certainty.

Both public and firefighter exposure to wildfire hazards, including smoke, would be progressively reduced over time because of the reduction in fuels associated with the prescribed burning of up to 2,000 acres. Although this alternative would treat more acres through prescribed burning (and mechanical treatment), additional acreage over that identified in Alternative B may be treated not just to reduce fuels, but to enhance or protect natural and cultural resources. The degree of beneficial impact in reducing the risk and/or extent of a large and intense wildfire would therefore be somewhat, but not significantly greater than that if Alternative B were implemented.

Wildland Fire and Suppression

Overall, there is no expected increase in fire-caused injuries to visitors, employees, and the public due to current suppression activities that average 30 acres per year.

Mechanical Treatment

Up to 1500 acres per year would be mechanically treated each year under this alternative. The foci of mechanical treatment would be primarily to control the spread of invasive exotic species and to reduce the risk or potential for spread of a wildfire. Forests would be thinned prior to prescribed burning and a fuel break along Inverness Ridge would be maintained. In combination with the reduced fuel loads from prescribed burning described above, firefighters and the public may experience a moderate benefit in the reduction of risk and extent of a large-scale and potentially dangerous wildfire.

As in other alternatives, closures and public information would prevent or minimize any impacts to the public from mechanical thinning or mowing equipment.

Public Education, Fire Research, and Fire Cache Construction

No differences beyond those identified in Alternative A would occur.

Under this Alternative, fire management personnel would be exposed to hazards of firefighting, smoke inhalation and the use of mechanical equipment over more acreage than in either of the other alternatives.

Cumulative Impacts

No cumulative impacts beyond those described under Alternative A would be expected.

Conclusion

Alternative C would have direct adverse, short-term, and minor impacts upon the health and safety of both the public and firefighters, except during large, high severity fire events, when the proximity of people to smoke and flame would result in major, short-term, and unavoidable adverse impacts.

A moderate benefit to public and park staff health and safety greater than that in Alternative B from the reduction of fuels through both prescribed fire and mechanical thinning and reduction in the risk of catastrophic fire would occur.

Public education, fire research, and fire cache construction would provide minor benefits by informing the public of prescribed burns and by reducing response time and increasing response effectiveness.

SOCIOECONOMIC IMPACTS

Alternative A

Impacts on Regional Economy

Under this alternative, the fire management program may have both direct and indirect impacts on the local economy (West Marin County) that is primarily driven by tourism spending. Direct impacts include the park's transactions with local businesses that supply goods and services for fire management activities. Additional direct impacts come from employees on the fire program payroll who procure personal housing, food, goods, and services from local businesses. Indirect impacts include the impact of fire management activities on tourism.

The analysis in this section primarily evaluates the costs and jobs associated with the core fire program envisioned under each alternative and compares it to the local economy. The core fire program includes preparedness and initial attack suppression capabilities and the costs associated with implementing a prescribed fire and mechanical treatment program. The analysis also compares the potential impacts of the actions proposed on the local economy and the potential loss or creation of jobs.

As noted in the Affected Environment, Point Reyes National Seashore received 2.35 million visitors in 2000 accounting for 930 travel party days/nights in the area. An average visitor party spends $94 per party per night in the local area ($109 if locals excluded). Total visitor spending was $87 million in 2000, $80 million excluding local visitors. This spending of visitors from visitors from outside the local region generates $69 million in sales by local tourism businesses, yielding $25.6 million in direct income and supporting 1,100 jobs. Each dollar of tourism spending yields another $.63 in sales through the circulation of spending within the local economy. Including these secondary effects, the total economic impact of tourism on the local economy is $113 million in sales, $42 million in wages and salaries, and 1,800 jobs (Michigan State University, 2001).

Under Alternative A, overall fire funding for operations is estimated at approximately $770,000 annually for wildfire suppression, mechanical treatments and prescribed fire. For the last three years, Point Reyes and GGNRA have received an additional $700,000 annually for Wildland Urban Interface (WUI) projects in the local community. Staffing for all aspects for fire management is approximately 13 Full Time Equivalents (FTEs; one person for a work year) (Wong, 2003). Employees may contribute to the economy as well by renting or buying housing and purchasing goods and services locally. Compared to the existing $155 million benefits of tourism overall, an additional $1.5 million would have only minor beneficial impacts. This is also true with jobs, as 13 staff compared to the 1,800 jobs created by tourism would have only minor benefits on the local economy. In addition, the 13 fire employees created compared to the 120,000 jobs in Marin County indicates beneficial impacts are minor (Marin County, 2003).

In any agency EIS, a section analyzing any impacts to minority or low-income populations from the proposed actions is required. The actions proposed in this alternative, including prescribed fire, mechanical treatment, and suppression of small or large wildfires, would have no disproportionate impact on minorities or low-income populations. In fact, most of the homes in the vicinity of the park are in the half-million dollar and up range.

Prescribed Fire Impacts on Local Economy

Under this alternative, 500 acres/year would be treated with prescribed fire. Based on past prescribed fires conducted at PRNS over the past 15 years, this Alternative would not result in the closure of any areas (usually 200 acres or less) for more than one or two days. Therefore, any adverse economic impacts from prescribed fire to tourism are short-term, negligible to the local economy. Some portion of the fire management budget and staffing is attributable to prescribed fire, with resulting negligible to minor beneficial impacts from fire operations spending, jobs and the purchase of goods and services by fire management staff.

Unplanned Ignitions, Wildfire, and Suppression Impacts on Local Economy

The park relies heavily on Marin County Fire Department for structural fire and wildland fire protection. The NPS is considered support and back up for large-scale events. In past years, unplanned ignitions (except large-scale fires) have not impacted the regional economy or the visitor population of the park. However, there have been short-term negligible impacts due to minor closures of areas during suppression for short periods, usually less than one day.

Under any of the alternatives, the build-up of fuels would continue as no alternative treats the entire study area; therefore, a large-scale wildfire at infrequent intervals in always a possibility. Socioeconomic impacts of such a fire may be similar to those associated with the Vision Fire in 1995. It consumed 48 homes and damaged an additional 18, resulting in property damage to structures estimated at $37 million. The economic impact to business is estimated to have been $1.365 million. The estimated for public service recovery (includes road repairs, water control facility repairs, debris removal, emergency protection measures) was estimated at $1.781 million. The total economic loss estimate was $40.146 million. Total suppression costs were estimated at $6.4 million (Marin County Fire Department, 1995).

Mechanical Treatments Impacts of Local Economy

Under this alternative, 500 acres/year at FMUs Estero, Limantour Road, Highway One, and Bolinas Ridge would be treated by mechanical means. Tomales Point, Headlands Inverness Ridge, Wilderness North, Wilderness South, Palomarin would only receive actions common to all alternative such as road maintenance and defensible space around structures. This level of treatment would not have a measurable effect on the regional economy or the visitor population. However, there have been short-term negligible impacts to the visitor experience and possibly therefore to the tourism economy due to minor closures of areas during mechanical treatment for safety reasons. As in prescribed burning, some portion of the fire management budget and staffing is attributable to mechanical treatments, with resulting negligible to minor beneficial impacts from fire operations spending, jobs and the purchase of goods and services by fire management staff.

Fire Information/Education on Local Economy

There are no beneficial or adverse impacts anticipated under this alternative.

Fire Cache/Park Headquarters Relocation, and Construction on Local Economy

The construction of a fire cache at Bear Valley would have a one-time cost of approximately $500,000. This would have a one-time beneficial, minor, economic effect on the local economy in terms of jobs and one time funding. .

Fire Effects and Fuel Management Research

There are no beneficial or adverse impacts to the local economy anticipated under this alternative.

Cumulative Impacts

Based on an analysis of the list of projects in Appendix C, the cumulative impacts of all the projects listed with this proposed action would have a beneficial minor effect on the local economy by the influx of some additional federal funding and a few jobs.

A large-scale wildfire that may or may not include land inside the project area would have a short-term adverse moderate effect on the regional economy and visitor population. For example, parts of the park could be closed for up to two months for rehabilitation, resulting in moderate negative impact to the local economy. In addition, the total damage to structures and public facilities resulting from the Vision Fire was estimated $40.146 million. Therefore, a large-scale fire would have a major impact on the local economy, both beneficial and adverse. The Vision Fire, for example, created a building surge due to reconstruction of the lost structures; however, as noted above, several homes were lost and millions spent to suppress the fire.

Conclusions

Under Alternative A, direct fire funding and staffing would have minor, long-term, beneficial impacts compared to dollars and staff positions generated from tourism in the local economy. No disproportionate impacts to low-income or minority populations would occur.

The prescribed burn program is not expected to result in more than very short-term closures of small areas, with no or negligible adverse impacts on tourism and the local economy. Areas may be closed during mechanical treatment, which because it lasts longer, may result in negligible to minor short-term impacts to tourism and the local economy.

In past years, unplanned ignitions (except large-scale fires; see cumulative impacts) have not impacted the regional economy or the visitor population of the park. However, there have been short-term, negligible impacts to the local economy due to minor closures of areas during suppression for short periods (less than one day).

Additional building and other projects in the Seashore would have a minor beneficial cumulative effect on the local economy. Cumulative effects from a larger wildfire, should it occur, could be major and both adverse and beneficial. Adverse impacts would result from the loss of property and money spent to suppress the fire, but benefits would also result from rebuilding and the influx of federal money.

Alternative B

Impacts on Regional Economy

Under Alternative B the number of acres treated by both prescribed burning and mechanical treatment would double to up to 1000 acres/year. Suppression activities would remain the same as in Alternative A. Based on the analysis, operating funds for fire management under this option would increase by $211,000 to about $1.7 million. Three additional jobs, or 16 FTEs would be created compared to No Action. With this level of spending and comparing it the jobs (1,800) and economic benefits of tourism ($155 million), direct fire operations spending and job creation has a beneficial long-term, but minor impact of the local economy. However, compared to No Action, spending would increase by 13%, and 23% more fire management personnel would be required. Compared to the entire regional economy, these increases would be negligible or minor; compared to the park's fire management operations in Alternative A, they would be minor to moderate increases.

The actions proposed in this alternative, including prescribed fire, mechanical treatment, and suppression of small or large wildfires, would have no disproportionate impact on minorities or low-income populations.

Prescribed Fire Impacts on Local Economy

Under this alternative, 1000 acres/year would be treated with prescribed fire. Based on past prescribed fires conducted at PRNS over the past 15 years, this alternative would not result in the closure of any areas (usually 200 acres or less) for more than one or two days. Therefore, any adverse impacts to the local economy from prescribed fire are short-term and negligible. This alternative would add some portion of the $1.7 million fire management budget to the local economy, and some or all of the 16 staff would spend money in the local communities for goods and services. While this is a minor benefit compared to spending overall in neighboring communities, it is possibly as much as a moderate benefit compared to these features of the No Action alternative.

Unplanned Ignitions, Wildfire, and Suppression Impacts on Local Economy

No changes in impacts from the implementation of Alternative B compared to Alternative A are expected.

Mechanical Treatments Impacts of Local Economy

Under this alternative, double the acres treated in No Action would be mechanically thinned. This level of treatment would not have a measurable effect on the regional economy or the visitor population. However, there have been short-term negligible impacts to the visitor experience and possibly therefore to the tourism economy due to minor closures of areas during mechanical treatment for safety reasons. Based on past experience in the park, visitors use other park areas with small areas are closed and do not leave the park; therefore impacts from reductions in tourism spending would not be more than negligible. As in prescribed burning, some portion of the fire management budget and staffing is attributable to mechanical treatment, with resulting beneficial impacts from fire operations spending, jobs and the purchase of goods and services by fire management staff. Although these would be negligible or minor compared to total local spending, they may be moderate benefits compared to similar spending conducted under No Action.

Fire Information/Education on Local Economy

As in Alternative A, there would be no beneficial or adverse impacts anticipated under this alternative.

Fire Cache/Park Headquarters Relocation, and Construction on Local Economy

As in Alternative A, construction of the fire cache would have a one-time beneficial, minor, economic effect on the local economy in terms of jobs and one time funding.

Fire Effects and Fuel Management Research

As in Alternative A, there would be no beneficial or adverse impacts to the local economy resulting from research.
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Cumulative Impacts

No additional cumulative impacts beyond those described under Alternative A are anticipated if Alternative B were implemented.

Conclusions

Under Alternative B, direct fire funding and staffing would have minor, long-term, beneficial impacts compared to dollars and staff positions generated from tourism in the local economy. Compared to spending in No Action, these benefits may be more moderate. No disproportionate impacts to minority or low-income populations would occur.

The prescribed burn program is not expected to result in more than very short-term closures of small areas, with no or negligible adverse impacts on tourism and the local economy. Areas may be closed during mechanical treatment, which because it lasts longer, may result in negligible to minor short-term impacts to tourism and the local economy.

In past years, unplanned ignitions (except large-scale fires; see cumulative impacts) have not impacted the regional economy or the visitor population of the park. However, there have been short-term, negligible impacts to the local economy due to minor closures of areas during suppression for short periods (less than one day).

Additional building and other projects in the Seashore would have a minor beneficial cumulative effect on the local economy. Cumulative effects from a larger wildfire, should it occur, could be major and both adverse and beneficial. Adverse impacts would result from the loss of property and money spent to suppress the fire, but benefits would also result from rebuilding and the influx of federal money.

Alternative C

Impacts on Regional Economy

Under Alternative C, actions include prescribed burn projects encompassing up to 2000 acres/year, mechanical treatment projects covering up to 1500 acres/year and a suppression program. Operating funds for fire management under this option would increase by $230,000 and five extra fire jobs would be created. With this level of spending and comparing it the jobs (1,800) and economic benefits of local tourism ($155 million), direct fire operations spending and job creation has a beneficial long-term, but minor impact of the local economy. However, compared to No Action, this is a 15% increase in direct spending and an increase of 38% in staffing. These benefits are moderate compared to No Action.

The actions proposed in this alternative, including prescribed fire, mechanical treatment, and suppression of small or large wildfires, would have no disproportionate impact on minorities or low-income populations.

Prescribed Fire Impacts on Local Economy

Under this alternative, 2000 acres/year would be treated with prescribed fire. Based on past prescribed fires conducted at PRNS over the past 15 years, this alternative would not result in the closure of any areas (usually 200 acres or less) for more than one or two days. Therefore, any adverse impacts to the local economy from prescribed fire are short-term and negligible. This alternative would add some portion of the $1.8 million fire management budget to the local economy, and some or all of the 18 staff would spend money in the local communities for goods and services. While this is a minor benefit compared to spending overall in neighboring communities, it is likely a moderate benefit compared to these features of the No Action alternative.

Unplanned Ignitions, Wildfire, and Suppression Impacts on Local Economy

No changes in impacts from the implementation of Alternative C compared to Alternative A are expected.

Mechanical Treatments Impacts of Local Economy

Under this alternative, triple the acres treated in No Action would be mechanically thinned. This level of treatment would not have a measurable effect on the regional economy or the visitor population. However, there have been short-term negligible impacts to the visitor experience and possibly therefore to the tourism economy due to minor closures of areas during mechanical treatment for safety reasons. Based on past experience in the park, visitors use other park areas with small areas are closed and do not leave the park; therefore impacts from reductions in tourism spending would not be more than negligible. As in prescribed burning, some portion of the fire management budget and staffing is attributable to mechanical treatment, with resulting beneficial impacts from fire operations spending, jobs and the purchase of goods and services by fire management staff. Although these would be negligible or minor compared to total local spending, they would be moderate benefits compared to similar spending conducted under No Action.

Fire Information/Education on Local Economy

As in Alternative A, there would be no beneficial or adverse impacts anticipated under this alternative.

Fire Cache/Park Headquarters Relocation, and Construction on Local Economy

As in Alternative A, construction of the fire cache would have a one-time beneficial, minor, economic effect on the local economy in terms of jobs and one time funding.

Fire Effects and Fuel Management Research

As in Alternative A, there would be no beneficial or adverse impacts to the local economy resulting from research.

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Cumulative Impacts

No additional cumulative impacts beyond those described under Alternative A are anticipated if Alternative C were implemented.

Conclusions

Under Alternative C, direct fire funding and staffing would have minor, long-term, beneficial impacts compared to dollars and staff positions generated from tourism in the local economy. Compared to spending in No Action, these benefits are likely to be moderate. No disproportionate impacts to minority or low-income populations would occur.

The prescribed burn program is not expected to result in more than very short-term closures of small areas, with no or negligible adverse impacts on tourism and the local economy. Areas may be closed during mechanical treatment, which because it lasts longer, may result in negligible to minor short-term impacts to tourism and the local economy.

In past years, unplanned ignitions (except large-scale fires; see cumulative impacts) have not impacted the regional economy or the visitor population of the park. However, there have been short-term, negligible impacts to the local economy due to minor closures of areas during suppression for short periods (less than one day).

Additional building and other projects in the Seashore would have a minor beneficial cumulative effect on the local economy. Cumulative effects from a larger wildfire, should it occur, could be major and both adverse and beneficial. Adverse impacts would result from the loss of property and money spent to suppress the fire, but benefits would also result from rebuilding and the influx of federal money.

MANDATORY SECTIONS

The following is a summary of three types of impacts that is required by the NEPA regulations that apply to all agencies. The first describes what each alternative sacrifices in terms of long-term sustainability to achieve short-term gain. The second section discusses the commitment of any irreversible (permanent loss or non-renewable resource) or irretrievable (short-term loss or loss of renewable resource) commitments of resource an alternative would require. The final section is a summary of any remaining more than minor adverse impacts that cannot be further mitigated.

Alternative A

Short-term Use Versus Long-term Enhancement of Resources

Fire management activities would result in some mortality of wildlife and vegetation, but would reduce threat of large, intense wildland fires. Short-term adverse impacts related to project activity would result in long-term beneficial impacts to restore more natural forest conditions. Without prescribed fire actions under Alternative A, the loss of fire as a factor in the long-term development of the forest ecosystem could adversely affect long-term productivity. Long-term adverse impacts are acceptable due to the beneficial impacts provided, and most long-term adverse impacts would be mitigated to less than significant. Prescribed fires may escape to become wildland fires. However, this risk is offset by the reduced risk of wildland fire ignition and high severity wildland fires when projects are completed.

Irreversible/Irretrievable Commitments of Resources

No irreversible/irretrievable commitments of resources would occur under Alternative A.

Unavoidable Adverse Impacts

Some native vegetation would be removed to reduce fuel levels and suppress wildland fires and indirectly affect wildlife. These adverse impacts are short-term and would be mitigated to a minor to moderate impact. Mitigation measures would minimize exotic plant species introduction and expansion, however, some adverse impact would still occur.

Alternative B

Short-term Use Versus Long-term Enhancement of Resources

Fire management activities under Alternative B that are greater than Alternative B and occur in more areas in the park would result in some mortality to wildlife and vegetation, but would reduce threat of large, intense, wildland fire (more than Alternative B). Short-term impacts related to project activity would restore more natural forest conditions and have long-term benefits to the natural ecosystem preservation. Prescribed fires may escape to become wildland fires. However, this risk is offset by the reduced risk of wildland fire ignition and high severity wildland fires when projects are completed.

Irreversible/Irretrievable Commitments of Resources

No irreversible/irretrievable commitments of resources would occur under Alternative B.

Unavoidable Adverse Impacts

Some native vegetation and wildlife would be adversely impacted to reduce fuel levels and suppress wildland fires. Mitigation measures should minimize any adverse impacts to minor or moderate over the long-term. Exotic plant species introduction and expansion would be mitigated to reduce any adverse impacts; however, some impact would still occur. Expanded prescribed burning (spring burns) could result in decreased reproduction of herbaceous species, depending on plant stage of development, phenology, and timing.

Alternative C

Short-term Use Versus Long-term Enhancement of Resources

Fire management activities under Alternative C would result in some mortality, but would greatly reduce threat of large, intense, wildland fire over the long run. This Alternative treats 3,500 acres per year. Short-term impacts related to project activity would restore more natural forest conditions and have long-term benefits to ecosystem preservation. Prescribed fires may escape to become wildland fires. However, this risk is offset by the reduced risk of wildland fire ignition and high severity wildland fires when projects are completed.

Irreversible/Irretrievable Commitments of Resources

No irreversible/irretrievable commitments of resources would occur under Alternative C.

Unavoidable Adverse Impacts

Some native vegetation would be removed to reduce fuel levels and suppress wildland fires and some associated wildlife would be adversely impacted. Mitigation measures would minimize any impacts to both vegetation and wildlife. Mitigation measures would minimize exotic plant species introduction and expansion, however, some adverse impact would still occur. Expanded spring burning and natural resource prescribed burning could result in decreased reproduction of herbaceous species, depending on plant stage of development, phenology, and timing. However, altering the timing of the burn to increase native species as research is conducted would mitigate these impacts.

CHAPTER 5: CONSULTATION AND COORDINATION

PUBLIC INVOLVEMENT AND SCOPING

During a series of scoping meetings, the NPS requested input from the public, from federal, state, and local agencies, and from park resource specialists on fire management concerns, the types of issues that should be addressed in the EIS, and the range of fire management alternative strategies that should be considered.

On January 27, 2000, a "Notice of Scoping for Fire Management Plan at Point Reyes National Seashore" was published in the Federal Register. On January 29, 2000, at a public meeting of the Point Reyes National Seashore Citizen Advisory Commission, a presentation was given announcing the scoping period for the plan. Scoping comments were solicited from January 27, 2000 to March 28, 2000.

In addition to the Federal Register Notice, the scoping period was publicized through a mass mailing to the public that included background information on the FMP and a notice of a scoping workshop held March 9, 2000. Notices posted in the communities surrounding the park and a notice in the local weekly newspaper, the Point Reyes Light, also advertised the workshop. The two-hour March 9 public scoping workshop was attended by five citizens.

On February 14, 2000 and on February 22, 2000, internal scoping sessions were conducted to identify staff issues and concerns. These meetings were attended by an interdisciplinary group of resource and fire specialists from the PRNS and GGNRA staff.

On March 28, 2000, a two-hour scoping session was held for local fire agencies. In addition to representatives of the NPS Fire Management Office, members of the Marin County Fire Department, Inverness Volunteer Fire Department, California State Parks, and Marin Municipal Water District were in attendance. Also invited, but not attending, were the Marin County Open Space District, Bolinas Fire Protection District, Nicasio Volunteer Fire Department, and Stinson Beach Fire Department.

In spring of 2001, the NPS conducted a two-hour meeting to provide an overview to the Marin County Fire Department of the preliminary alternatives, and consulted on possible changes and/or modifications.

The draft EIS for the Fire Management Plan was released for public comment on February 20, 2004. The comment period closed April 20, 2004. Seven written comment letters were received; they are addressed below.

The Federated Indians of Graton Rancheria have been consulted for compliance with the Native American Graves Protection and Repatriation Act.

COMPLIANCE STATUS

Documentation of NPS compliance with federal and state laws and regulations is incorporated into the text of the FEIS. Compliance with the nine major federal laws, executive orders, and associated state regulations is summarized here.

National Environmental Policy Act (NEPA) of 1970. PL 91-190, 83 Stat. 852, 42 USC §4341 et seq. The Final EIS provides disclosure of the planning and potential environmental consequences of the proposed action and alternatives, as required by NEPA. All substantive comments received on the draft EIS are responded to in this final EIS. In addition, an alternative is identified as preferred. A record of decision will be published 30 days following publication of the final plan and environmental impact statement. It will identify the selected alternative, which, barring unforseen circumstances, will be the same as the preferred alternative in the final EIS (Alternative C). At that time, the selected alternative will be implemented.

Endangered Species Act of 1973, as amended, PL 93-205, 87 Stat. 884, 16 USC §1531 et seq. The Endangered Species Act protects threatened and endangered species, as listed by the U.S. Fish and Wildlife Service, from unauthorized take, and directs federal agencies to ensure that their actions do not jeopardize the continued existence of such species. Section 7 of the act defines federal agency responsibilities for consultation with the U.S. Fish and Wildlife Service and National Marine Fisheries Service (for fish) and requires preparation of a Biological Assessment to identify any threatened or endangered species that is likely to be affected by the proposed action. The National Park Service initiated consultation on February 9, 2001 and continues consultation with the U.S. Fish and Wildlife Service and the National Marine Fisheries Service. See Appendix D for biological opinion from the USFWS.

Archeological Resources Protection Act of 1979, PL 96-95, 93 Stat. 712, 16 USC §470aa et seq. and 43 CFR 7, subparts A and B, 36 CFR. This act secures the protection of archeological resources on public or Indian lands and fosters increased cooperation and exchange of information between private, government, and the professional community in order to facilitate the enforcement and education of present and future generations. It regulates excavation and collection on public and Indian lands. It requires notification of Indian tribes who may consider a site of religious or cultural importance prior to issuing a permit. The NPS will meet its obligations under this Act in all activities conducted in the Fire Management Plan.

National Historic Preservation Act of 1966, as amended, PL 89-665, 80 Stat. 915, 16 USC §470 et seq. and 36 CFR 18, 60, 61, 63, 68, 79, 800. The National Historic Preservation Act requires agencies to take into account the effects of their actions on properties listed in or eligible for listing in the National Register of Historic Places. The Advisory Council on Historic Preservation has developed implementing regulations (36 CFR 800), which allow agencies to develop agreements for consideration of these historic properties. The NPS, in consultation with the Advisory Council, the California State Historic Preservation Officer (SHPO), American Indian tribes, and the public has developed a Programmatic Agreement for operations and maintenance activities on historic structures. This Programmatic Agreement provides a process for compliance with National Historic Preservation Act, and includes stipulations for identification, evaluation, treatment, and mitigation of adverse effects for actions affecting historic properties. The NPS sent a scoping notice to the state historic preservation officer and the Advisory Council for Historic Preservation to initiated consultation. Consultation will continue throughout the planning process.

American Indian Religious Freedom Act, PL 95-341, 92 Stat. 469, 42 USC §1996. This act declares policy to protect and preserve the inherent and constitutional right of the American Indian, Eskimo, Aleut, and Native Hawaiian people to believe, express, and exercise their traditional religions. It provides that religious concerns should be accommodated or addressed under NEPA or other appropriate statutes. The National Park Service, as a matter of policy, will be as nonrestrictive in permitting Native American access to and use of an identified traditional sacred resource for traditional ceremonies.

Executive Order 11988: Floodplain Management. This Executive Order requires federal agencies to avoid, to the extent possible, adverse impacts associated with the occupancy and modification of floodplains, and to avoid development in floodplains whenever there is a practical alternative. If a proposed action is found to be in the applicable regulatory floodplain, the agency shall prepare a floodplain assessment, known as a Statement of Findings. All of the actions proposed in the Fire Management Plan are consistent with this executive order.

Executive Order 11990: Protection of Wetlands. This Executive Order established the protection of wetlands and riparian systems as the official policy of the federal government. It requires all federal agencies to consider wetland protection as an important part of their policies and take action to minimize the destruction, loss or degradation of wetlands, and to preserve and enhance the natural and beneficial values of wetlands. All of the actions proposed in the Fire Management Plan are consistent with this executive order

Executive Order No. 13112: Invasive Species. This Executive Order prevents the introduction of invasive species and directs federal agencies to not authorize, fund, or carry out actions that it believes are likely to cause or promote the introduction or spread of invasive species. Actions proposed in the FEIS include measures to prevent the introduction and spread of invasive species.

California Coastal Zone Management Act. This act protects coastal environments. While this act transferred regulatory authority to the States and excluded federal installations from the definition of the “coastal zone,” it requires that federal actions be consistent with state coastal management plans. Activities taking place within the coastal zone under the definition established by the California Coastal Management Plan require a federal consistency determination. The FEIS will be submitted to the Coastal Commission for federal consistency determination.

LIST OF PREPARERS

Dawn Adams, Inventory and Monitoring Coordinator, BS, General Biology, University of Illinois.

Barbara Moritsch, Plant Ecologist; BS, Resource Planning and Interpretation, Humboldt State University; MS, Environmental Science, Oregon State University.

Natalie Gates, Wildlife Biologist; BA, Biology, Harvard University; DVM Cornell University; MS, Environmental Science and Policy, University of California, Berkeley Campus.

Sarah Allen, Ph.D, Science Advisor, University of California, Berkeley Campus, MS at University of California, Berkeley Campus; BS, Conservation of Natural Resources, University of California, Berkeley Campus.

Don Neubacher, Superintendent; BS, Environmental Planning, University of California, Davis Campus; MS Resource Management, Humboldt State University.

Brannon Ketcham, Hydrologist, BA, Geology, Ponoma College; MEM, Water Resources Management, Duke University.

Wendy Poinsot, Environmental Planner, BA, Park History, Colorado State University.

Roger Wong, Fire Management Specialist, BS, Forestry, University of California, Berkeley.

Gary Fellers, Ph.D, Research Scientist, US Geological Services, Biological Resources Division.

Gordon White, Historical Architect, MA, Architecture, University of California, Berkeley.

Jane Rodgers, Plant Ecologist, BS, Forestry, University of California, Berkeley.

LIST OF CONSULTANTS

URS: Jeremy Rowlands, Air Quality
Chris Johnson, Air Quality

Heidi West, Ph.D., Total Quality NEPA

PARTICIPATING GOVERNMENTAL AGENCIES

List of Agencies and Organizations to Whom Copies or Notice of the Final Environmental Impact Statement have been Sent

Federal Agencies
U. S. Army Corps of Engineers

U. S. Coast Guard
U. S. Department of Commerce National Oceanic and Atmospheric Administration
U. S. Geological Service
U. S. Fish and Wildlife Service
U. S. Natural Resources Conservation Service
U. S. National Marine Fisheries

Federal Advisory Groups
Advisory Council for Historic Preservation

Elected Officials
California State Assemblyperson Joe Nation
California State Senator John Burton
Marin County Supervisor Steve Kinsey
U. S. Representative Lynn Woolsey
U. S. Senator Barbara Boxer
U. S. Senator Dianne Feinstein

State Agencies
Bay Area Air Quality Management District
Bodega Marine Lab
California Coastal Commission
State of California Department of Environmental Science
State of California Department of Fish and Game
State of California Department of Parks and Recreation
State of California Department of Transportation
State of California Office of Planning and Resources State Clearinghouse
State Historic Preservation Office
University of California, Berkeley
University of California Cooperative Extension

Regional, County, and Municipal Agencies
Bolinas Fire Department
Bolinas Community Public Utility District
Inverness Fire Department
Marin Humane Society
Marin County Community Development Agency
Marin County Fire Department
Marin County Open Space
Marin County Planning and Acquisition
Marin County Sheriff’s Department
Marin County Resource Conservation District
Marin Municipal Water District
Nicasio Fire Department
San Francisco Regional Water Quality Control Board
Sonoma County Agriculture Preservation and Open Space District

Sonoma County Water Agency

Non-Governmental Organizations, Non-Profit Organizations, etc.

Animal Protection Institute
Audubon Canyon Ranch & Cypress Grove Preserve
Bay Area Ridge Trail Council
Bay Institute
Bayrose Morgans
Bicycle Trails Council
Bolinas Community Parks Planning
California Native Plant Society
Coastwalk
Committee for the Preservation of Tule Elk
Defenders of Wildlife
East Shore Planning Group
Environmental Action Committee of West Marin
Environmental Forum of Marin
Federated Indians of Graton Rancheria
Friends of the Estero
Gardener’s Guild
In Defense of Animals
Inverness Association
Inverness Ridge Association
Marin Agricultural Land Trust
Marin Audubon Society
Marin Conservation League
Marin County Farm Bureau
Marin Horse Council
Mow Our Weeds
National Parks and Conservation Association
National Trust for Historic Preservation
North American Trail Ride Conference
Point Reyes Bird Observatory
Point Reyes Light
Point Reyes Village Association
Preserve Historic Olema Valley
Sierra Club, Marin Group
Sonoma Horse Council
Sonoma County Farm Bureau
Sustainable Conservation
Tomales Bay Advisory Committee
Trout Unlimited
Trust for Public Lands
Vedanta Society
Waste Watch
West Marin Chamber of Commerce

West Marin Community Radio
West Marin Paths
Wilderness Society

Libraries
Bolinas Library
Inverness Library
Marin County Library
Point Reyes Library
Stinson Beach Library
Marin County Civic Center Library
San Francisco Main Public Library

COMMENTS RECEIVED AND NPS RESPONSES TO COMMENTS

I. Introduction

In accordance with the National Environmental Policy Act (NEPA) and National Park Service (NPS) policy on compliance with NEPA, all substantive comments received during the 60-day public comment period for the Point Reyes National Seashore Fire Management Plan, Environmental Impact Statement (EIS), were considered and responded during the preparation of this Final EIS. Substantive comments are generally defined as those that raise, debate or question, within a reasonable basis, the accuracy of the information presented or adequacy of the range of alternatives or assessment conducted. Other comments received, such as those that focus on agency policy, express a preference for an alternative or address issues beyond the scope of fire management planning at Point Reyes National Seashore (PRNS) are noted without specific response.

A notice of availability for the Draft EIS was published in the federal register and the document made available for public review on February 20,2004. The 60-day public comment period ended on April 20, 2004. A public workshop to provide information to the public on the Draft EIS was held at the Red Barn meeting room at PRNS on the evening of March 18,2004. No verbatim recording of the discussion at the meeting was made in order to allow an informal question and answer format, which is difficult to transcribe. NPS staff gave a presentation on fire management planning actions at PRNS and more specifically on the proposed alternatives presented in the Draft EIS. The presentation was followed by an open question and answer period with the public. The public was encouraged to submit comments on the FMP Draft EIS to NPS offices at PRNS by email, fax or regular mail.

The FEIS will be mailed to the same distribution list as the DEIS. Both the DEIS and this FEIS will be available on the PRNS website at: www.nps.gov/pore/pphtml/documents.html.

This section of the Final EIS is structured as follows:

I. Introduction

II. Comment Letters. *Seven comment letters on the Draft EIS were received. Each letter is numbered, as is each specific comment within the letter. The markup on the letters in this chapter should be used as an index to find the appropriate response to that comment in Chapter III.*

III. Comments Received and Response to Comments. *Responses are presented for substantive comments. Solely to facilitate the matching of comments and responses between the two chapters, each specific comment is presented in a brief paraphrase. The full comment can be referenced in Chapter II. Any changes needed to Draft EIS text based on the specific comment are noted in the response with underline marking new text and strikeout noting deleted text.*

II. Comment Received and Response to Comments

[Note: Changes to be made to Draft EIS text are presented as ~~strikeout~~ for removed text and <u>underline</u> for new or replacement text.]

Comment Letter 1. United States Environmental Protection Agency, San Francisco, CA. Lisa B. Hanf, Manager, Federal Activities Office.

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
REGION IX
75 Hawthorne Street
San Francisco, CA 94105-3901

L7617

RECEIVED
Point Reyes National Seashore
APR 21 04

April 15,2004

Don Neubacher, Superintendent
Point Reyes National Seashore
Point Reyes, CA 94956

Subject: Draft Fire Management Plan and Draft Environmental Impact Statement (DEIS) for Point Reyes National Seashore and North District of Golden Gate National Recreation Area [CEQ #040066]

Dear Mr. Neubacher:

The U.S. Environmental Protection Agency (EPA) has reviewed the above referenced document. Our review and comments are provided pursuant to the National Environmental Policy Act (NEPA), the Council on Environmental Quality's NEPA Implementation Regulations at 40 CFR 1500-1508,and Section 309 of the Clean Air Act.

We have rated this DEIS as LO -- "Lack of Objections" (see enclosed "Summary of Rating Definitions"). Alternative C is the National Park Service's preferred alternative because it would involve increased efforts to enhance natural resources while reducing hazardous fuels. While we support this alternative, we have a few additional recommendations.

Comment 1-1

The DEIS indicates that all watersheds sampled for the Point Reyes National Seashore Water Quality Monitoring Report had total suspended solids that exceed the recommended standard. Furthermore, Tamales Bay and Lagunitas Creek and Walker Creek watersheds are listed as impaired waters under Clean Water Act Section 303(d). It is unclear from the DEIS what specific measures will be taken to improve water quality in these watersheds. We recommend that your office work closely with the California Regional Water Quality Control Board (CRWQCB) to develop specific management measures that will not only offset fire management impacts, but actually improve water quality in these watersheds. These measures should be described in the Final Environmental Impact Statement (FEIS).

Comment 1-2

The CRWQCB recently released the proposed total maximum daily load (TMDL) and implementation strategy for pathogens in Tomales Bay, and will be developing and adopting TMDLs and their implementation plans over the next several years for the other pollutants impairing Tomales Bay, Lagunitas Creek and Walker Creek. We recommend that your office work closely with the CRWQCB as you develop individual burn plans to ensure consistency with the TMDL implementation plans as they are developed for these impaired watersheds.

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Comment 1-1. In light of exceedences of levels of total dissolved solids (TSS) noted in the DEIS for PRNS watershed, the US EPA recommends that NPS work closely with the RWQCB and develop specific management measures to offset potential effects of fire management actions and to improve water quality overall.

Response to Comment I- I. The NPS is working in conjunction with the RWQCB, and in partnership with ranchers leasing lands within PRNS, to implement agricultural improvements aimed at reducing impacts on water quality. The park and leaseholders have developed several initiatives to reduce the levels of TSS and other pollutants and correct source areas for erosion on the ranchlands. Examples of these initiatives include the McClure diary barn, funded entirely by the leaseholder, which will house their herd during the winter, permitting their removal from several open pastures during rainy season. On this and other ranches, PRNS has fenced cattle out of creek channels, seasonal drainages and wetlands. On the Stewart Ranch, a grassed buffer strip was construction between high use horse pens and Olema Creek to filter out sediment from runoff. Sediment basins were constructed at the Nunes and Giacomini Ranches to trap runoff from the concentrated use areas of the ranches and avoid deposition of the runoff into creeks and drainages.

Comment 1-2. US EPA recommends that the NPS work with RWQCB to assure that FMP actions not only offset potential project affects but work to improve water quality in the Tomales Bay, Lagunitas Creek and Walker Creek watersheds. The NPS should assure that prescribed burn plans remain consistent with the Total Maximum Daily Level (TMDL) implementation plans currently being developed.

Response to Comment 1-2. Mitigation measures to protect water quality and water resources are listed in the Draft EIS on pages 57-58. Measure W-1 calls for a review of the erosion control plan for each prescribed burn. In response to Comment 1-2, the following text change will be made to Mitigation Measure W- 1 in the Final EIS:

W-1. Individual burn plans will ~~would~~ be written with enough detail to determine the extent of erosion within the burn area due to a) the prescribed burn and/or, b) mechanical treatments. Subject matter experts will ~~would~~ determine if the erosion control plan submitted is sufficient to prevent long-term moderate or major impacts to the water resources and water quality and will assure project compliance with the TDML implementation plans for Tomales Bay, Lagunitas Creek and Walker Creek, according to availability through adoption by the EPA. Strategies to minimize erosion and sediment transport to water resources associated with prescribed burning include avoiding overly steep slopes, timing burns to minimize erosion potential, or using erosion control devices after bums. Strategies to minimize erosion and sediment transport to water resources associated with mechanical treatment include avoiding overly steep slopes, avoiding scraping or clearing to bare mineral soil (leave duff layer), or installing erosion control devices as part of mechanical treatment (if necessary).

Comment 1-3

The DEIS indicates that your office initiated consultation with the U.S. Fish and Wildlife Service in 2001 for this fire management plan. We recommend that the biological opinion for this plan be included in the FEIS.

We appreciate the opportunity to review this DEIS and request a copy of the FEIS when it is filed with our Washington, D.C. office. If you have any questions, please call me at (415) 972-3854, or have your staff call Jeanne Geselbracht at (415) 972-3853.

Sincerely,

Lisa B. Hanf

Lisa B. Hanf, Manager
Federal Activities Office

004315

Enclosure

2

Comment 1-3. US EPA recommends that the biological opinion from the US Fish and Wildlife Service for the PRNS FMP be included in the FEIS.

Response to Comment 1-3. The biological opinions received from the US Fish and Wildlife Service and the National Oceanic and Atmospheric Administration on the FMP are included in this Final EIS. The biological opinions present the conclusions of these agencies on the potential affect of the FMP on species listed by the federal government under the Endangered Species Act.

Comment Letter 2. Bay Area Air Quality Management District, San Francisco. Jack Broadbent, Executive Officer/APCO.

04/26/2004 11:48 4159288568 BAY AREA AIR QUALITY PAGE 01/03

L7617

BAY AREA AIR QUALITY MANAGEMENT DISTRICT

RECEIVED APR 26 '04 Point Reyes National Seashore

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April [illegible], 2004

Don L. Neubacher
Superintendent
Pt. Reyes National Seashore
National Park Service
Pt. Reyes, CA 94956

Subject: Pt. Reyes National Seashore Draft Fire Management Plan

Dear Mr. Neubacher:

The Bay Area Air Quality Management District (District) staff have received your agency's Draft Environmental Impact Statement (DEIS) for the Pt. Reyes National Seashore Draft Fire Management Plan (FMP). The FMP provides a 10-15 year framework for all fire management activities for Pt. Reyes National Seashore and the North District of the Golden Gate National Recreation Area, including suppression of unplanned ignitions, prescribed burns, and mechanical fuel treatments. The DEIS describes and analyzes a preferred alternative and two other alternatives for future management of the park's fire program. The preferred alternative (Alternative C – Increased Natural Resource Enhancement and Expanded Hazardous Fuel Reduction) would allow for up to 3,500 acres of prescribed fire and mechanical treatments. After our review of the FMP and DEIS, we have the following comments to submit.

We are concerned by the statement on page 31 of the DEIS that vegetation debris may be hauled, stockpiled and burned at Beebe Ranch. The District's Regulation 5 for hazardous materials fires does not allow the movement of vegetation debris to a central location for pile burning unless approved by the Air Pollution Control Officer. Please revise the FMP and DEIS to reflect our regulation. **Comment 2-1**

We request that page 34 of the DEIS be amended to include the reporting of any wildland fire event to the BAAQMD. It is important that we are informed of such events in order to monitor their effects upon Bay Area air quality. **Comment 2-2**

Both the General Description of Prescribed Fire Treatments section in Chapter 2 and Regulations and section in Chapter 4 should be to reflect appropriate and for conducting prescribed burning in the Ray Area (*pages* 36-37, *177*). In order to obtain an acreage burning allocation from the BAAQMD for conducting a prescribed bum, a completed prescribed burning smoke management plan (SMP) must be submitted to the BAAQMD at least 30 days prior to burning. Once the *SMP* is approved, burning on a permissive bum day is allowed. only after receiving an acreage burning allocation from the BAAQMD. To obtain final approval to bum, the SAAQMD should be called at (415) 749-4600 between 8:30 am and 1:30pm on **Comment 2-3**

939 ELLIS STREET • SAN FRANCISCO CALIFORNIA 94109 • 415.771.6000 • www.baaqmd.gov

APR-26-2004 12:43 4159288568 90% P.02

Comment 2-1. Please revise Draft EIS text on page 31 to conform with BAAQMD Regulation 5 which does not allow the movement of vegetation debris to a central location for pile burning unless approved by the Air Pollution Control Officer.

Response to Comment 2-1. Draft EIS text on page 31 is revised as follows in the Final EIS:

> "Tools used for these tasks include weed-whackers, chain saws, pole saws, and a chipper towed to the site by a truck. Vegetation debris can be cut up and broadcast in the immediate area, or piled and bumed. Debris that is not broadcast on site is chipped and hauled to Beebe Ranch and stockpiled. In accordance with BAAQMD Regulation 5, debris piles ~~are burned at~~ could only be burned at Beebe Ranch with the approval of the Air Pollution Control Officer. Chipped material is not burned."

Comment 2-2. Please revise Draft EIS text on page 34 to include reporting wildland fires to BAAQMD.

Response to Comment 2-2. Draft EIS text on page 34 is revised as follows in Final EIS:

> "In the event of wildland fire, the P/FIO would work closely with visiting FIOs who may be part of Incident Management Teams to assure the park message is delivered accurately and effectively. Wildland fires will also be reported to the BAAQMD as soon as possible. Media and public queries would receive prompt replies and would contain information about the fire, the fire management plan, and ecosystem restoration as appropriate."

Comment 2-3. Please revise Draft EIS text on pages 36 to 37 and page 177 to reflect BAAQMD approval procedures for prescribed bums and correct that all prescribed bums require BAAQMD approval and submittal of a bum plan.

Response to Comment 2-3. Draft EIS text on pages 36-37 is revised as follows in Final EIS. Note that the order of some of the text has been changed.

The bum plan is submitted to an outside expert, and both the expert and the park's Fire Management Officer provides a recommendation to the superintendent. After the burn plan is approved by the superintendent, an application for permission to conduct a prescribed bum is made to the BAAQMD.

The bum plan estimates the percentage of the unit covered by different fuel types and of the tons of material to be burned. This information is fed into an air quality model for the bum, which is submitted as part of the application for approval submitted ~~application to the Bay Area Air Quality Management District (~~BAAQMD). BAAQMD approval requires that the NPS submit a smoke management plan (SMP) and completed application materials for all prescribed bums at least 30 days prior to the proposed burn date.

With the approval of the smoke management plan, the NPS begins final planning for the prescribed bum and the project site is prepped for the burn. To prepare for a burn in grassland habitat, a line is mowed around the perimeter of the burn by cutting grasses with either a weed whacker, mower, or tractor. In shrub or forested habitats a fire line (approximately 18 to 24 inches wide) is cut and cleared and vegetation density reduced as described above under the heading “Suppression of Unplanned Ignitions”. Whenever possible, roads and trails are used as fire lines to reduce the amount of line that must be created. A hose lay is set up along the burn perimeter no more than one week prior to the bum. If the bum is being conducted in non-native tree or shrub stands (e.g., Monterey pine or Scotch broom), the non-natives may be cut down or mowed and left in the burn unit to dry before burning. This increases mortality of the targeted non-native species.

As the proposed burn day approaches, NPS staff contact BAAOMD’s Meteorology and Data Analysis section which provides forecasting services to assist with tentative scheduling of prescribed bums. The MDA section will provide 96-hour, 72-hour, 48-hour and 24-hour forecasts and a 24-hour confidence level of receiving the final approval on the day of the burn itself. The *NPS* telephones BAAQMD between 8:30 a.m. and 1:30 p.m. on the burn day to receive final approval and an acreage burning allocation for that day. BAAQMD requires verification that the meteorological conditions fall within the range described in the SMP. ~~On the day of the prescribed fire~~, The BAAQMD makes a final decision based on wind and weather as to whether it would permit the burn.

Prescribed fire personnel monitor the fire until dark or until the perimeter is secured. Personnel would stay on site overnight for burns in forested habitats. The burn area is patrolled the day after burning by walking the perimeter and doing any additional mop up activities required. As required by BAAOMD, the total acreage of burned vegetation is reported by telephone to them noon the day following the prescribed burn.”

Revisions on Page 176, paragraph 4 in DEIS.

“San Francisco Bay Area Air Quality Management District (BAAQMD). BAAQMD is the air quality management district for the project area and has primary responsibility for control of air pollution from prescribed burning. BAAQMD has procedures that must be followed prior to implementation of a prescribed bum plan. For all prescribed fire, ~~fires less than 100 acres, BAAQMD requires that burns be conducted on an “allowable burn day” unless the district has granted a variance I advance. Notice of an allowable burn day is posted by the BAAQMD each afternoon for burns planned for the following day. Following the burn, the fire agency must submit information on the fuel types burned to BAAQMD. Burns 100 acres or larger in size~~ BAAQMD requires submission of the individual bum plan ~~to the BAAQMD~~ at least one month prior to the proposed bum. BAAQMD then issues a forecast 72 hours prior to the proposed date and gives a final commitment to permit the burn on the day of the bum itself though forecasts with increasing confidence can be obtained at 96-hours, 72-hours, 48-hours and 24-hours prior to the burn day to support moving forward on all the logistical planning needed to conduct a prescribed burn. ~~48 hours prior to the date allowing flexibility in planning needed for larger burns.”~~

the burn day to request an acreage burning allocation and to confirm the burn day status. The BAAQMD provides prescribed burn forecasting services to assist with the tentative scheduling on a permissive burn day. Our Meteorology and Data Analysis (MDA) section can be reached at (415) 749-4915. The MDA section can provide 96-hour, 72-hour, 48-hour, and 24-hour forecasts and a 24-hour confidence level of receiving the acreage burning allocation desired for the following day.

Comment 2-3

Prescribed burning is not allowed until an acreage burning allocation has been received by the BAAQMD. In addition, the meteorological conditions from the approved SMP must be verified prior to ignition. The BAAQMD requires that the total acreage of burned vegetation be reported back to us by noon on the following day. In addition to calling the phone number provided earlier, current burn day status can also be obtained by calling the BAAQMD Burn Status Recording line at (800) 792-0787. After 3:00 pm, the recording also provides the following day's burn forecast. A prescribed burn of any size, not just 100 acres or more, as incorrectly stated on page 177, must satisfy these requirements and follow these procedures.

Comment 2-4

We understand that part of the preferred alternative may include prescribed burning for wetland areas within the Park. Burning in wetlands is subject to marsh management fire requirements found in sections 401.13 and 410 of Regulation 5: Open Burning. Please visit our website for more details on the District's Policies and Procedures for this regulation: http://www.baaqmd.gov/enf/otherinfo/PNP/REG5_PNPfinal.pdf.

Comment 2-5

Table 37 on page 175 should be revised to show the Bay Area's current attainment status. The Bay Area is currently a nonattainment area for federal and state ambient air quality standards for ground level ozone and state standards for particulate matter. Earlier this month, the Bay Area was designated as a nonattainment area for the new federal 8-hour ozone standard. The air quality standards are set by the national and state governments at levels to protect public health and welfare.

Comments 2-6 2-7 2-8

We are concerned about the lack of detail in the DEIS concerning the National Park Service's responsibility with regards to the Clean Air Act's Regional Haze Regulation and discussion on how the preferred alternative's impacts upon regional haze can be mitigated. As a Class I airshed, Pt. Reyes is a critical natural area that the federal government has determined needs visibility improvement. In addition to the projected annual fire management emissions for all three alternatives (*Tables 44, 46 and 48*), please provide estimates of the number of burn days per year and the associated amount of daily emissions in tons per day. On page 174, the DEIS describes the recent findings of a cooperative program, the Interagency Monitoring of Protected Visual Environments (IMPROVE), that visibility in the park improved between 1996 and 1999. Please provide information on the monitoring site where IMPROVE data was collected, especially the site's location relative to fire activity including the appropriate fire management unit. This information will help explain the FMP's daily impact on regional haze relative to where visibility monitoring will occur to determine compliance with the upcoming federal regional haze requirements.

Comment 2-4. Burning in wetlands requires conformance with BAAQMD Regulation 5, Sections 40 1.13 and 410 which describe marsh management fire requirements.

Response to Comment 2-4. The following additional text will be inserted as a new paragraph in the Final EIS on page 298, paragraph 1, Prescribed Fire.

<u>Burn plans that include prescribed burning in wetland areas are subject to the conformance with additional regulations when applying to BAAQMD. In addition to the SMP and other submittals, Regulation 5, Section 410, Marsh Management Burn Requirements, asks for an evaluation of non-burning alternatives that could achieve land management objectives in keeping with resource management plans that apply to the project area. Regulation 5, Section 401.13 includes more detailed guidance for planning prescribed burns that involve wetland acreage.</u>

Comment 2-5. Table 37 does not reflect current attainment status.

Response to Comment 2-5. Table 37 is revised as requested.

Pollutant	Averaging Time	California Standards[1]		National Standards[2]	
		Concentration	Attainment Status	Concentration[3]	Attainment Status
	8 hour			0.08 ppm	<u>N</u>
Ozone (O^3)	1 hour	0.09 ppm (180 μg/m^3)	N	0.l2 ppm (235 μg/m^3)	N[4]

Comment 2-6. More detail is needed on how the preferred alternative’s impacts on regional haze can be mitigated.

Response to Comment 2-6. Mitigation measures that address the impacts of the preferred alternative on regional haze are found on DEIS pages 56 and 57, particularly measures A-1, A-2, A-5, A-6 and A-7 and are included in the Final EIS.

Comment 2-7. Please provide estimates on the number of burn days per year and the associated amount of daily emissions in tons per day.

Response to Comment 2-7. The Point Reyes National Seashore Fire Management Officer, Roger Wong, has provided a per event breakdown of the annual estimated emissions listed in the FMP EIS.

Daily Emissions for FMP Alternatives
(all emission levels given in tons per burn day)

Alternative	Acres treated	Burn Days per year	PM_{10}	$PM_{2.5}$	Methane	CO	NO_x
Alternative A	500 acres	10 total burn days					
Grass scrub	495 acres	9	2.3	2.0	0.6	5.1	0.1
Understory	5 acres	1	2.9	2.4	1.4	28.3	0.8
Alternative B	1000 acres	20 total burn days					
Grass scrub	849 acres	15	2.5	2.0	0.6	5.1	0.1
Understory	153 acres	5	17.5	15.0	8.4	173.3	5.0

Alternative C	2000 acres	35 total burn days					
Grass scrub	1,724 acres	20	3.9	3.3	1.0	8.2	0.2
Understory	276 acres	15	10.5	8.9	5.0	104.2	3.0

The annual maximum acreages of prescribed burning were developed with the assumption that the program described in the alternative would be implemented with optimum funding and staffing to support this level of activity from an operational stand point. For purposes of these emission estimates, "per event" should be considered equivalent to "per day". If, subsequent to the NEPA process, the park does not receive optimum funding for implementation of the FMP, the amount of acreage treated annually could be considerably less than proposed in the EIS. With that possibility acknowledged, the emissions presented in the EIS may overstate emissions generated as the FMP is implemented.

Comment 2-8. Please provide information on the monitoring site where IMPROVE data cited on page 174 was collected.

Response to Comment 2-8. Air quality monitoring at Point Reyes National Seashore has included particulate matter (PM2.5 and PM10), hourly ozone, and SO2 (see Table VII-3 below). The aerosol sampler in the park began operation in March of 1988. It is located at the North District Ranger Station, south of Tomales Bay State Park and north of Point Reyes Hill in the Inverness Ridge FMU. The location of the aerosol sampler is shown in Figure VII-3 excerpted from Assessment of Air Quality and Air Pollutant Impacts in Class I National Parks of California (April 2001). The status of Point Reyes air quality is Chapter VII of the full report which can be found on the NPS Air Quality website at:
http://www2.nature.nps.gov/air/Pubs/CAreview/CAreport.pdf. The automatic 35mm camera was located on a peninsula at the south-west comer of Drakes Bay and operated from June 1987 through April 1995. The camera viewed east across Drakes Bay towards the Point Reyes Wilderness area.

Table VII-3. Air quality monitoring at PORE

Species	Site within park	Site within 50 km
Ozone, hourly	NPS**	
Ozone, passive	NPS*	
SO2	NPS	
PM10	IMPROVE	
PM2.5	IMPROVE	
Wet deposition		ARB**
Dry deposition		
Visibility		

* New site
** Closed before 1994

For more information on the District's prescribed burning requirements and policies, please contact Doug Tolar, Air Quality Specialist II, in our Compliance and Enforcement Division at (415) 749-5118. If you have any questions regarding these comments, please contact Suzanne Bourguignon, Environmental Planner, at (415) 749-5093.

Sincerely,

Jack P. Broadbent

Jack P. Broadbent
Executive Officer/APCO

JPB:SB

cc: BAAQMP Director Harold C. Brawn, Jr.

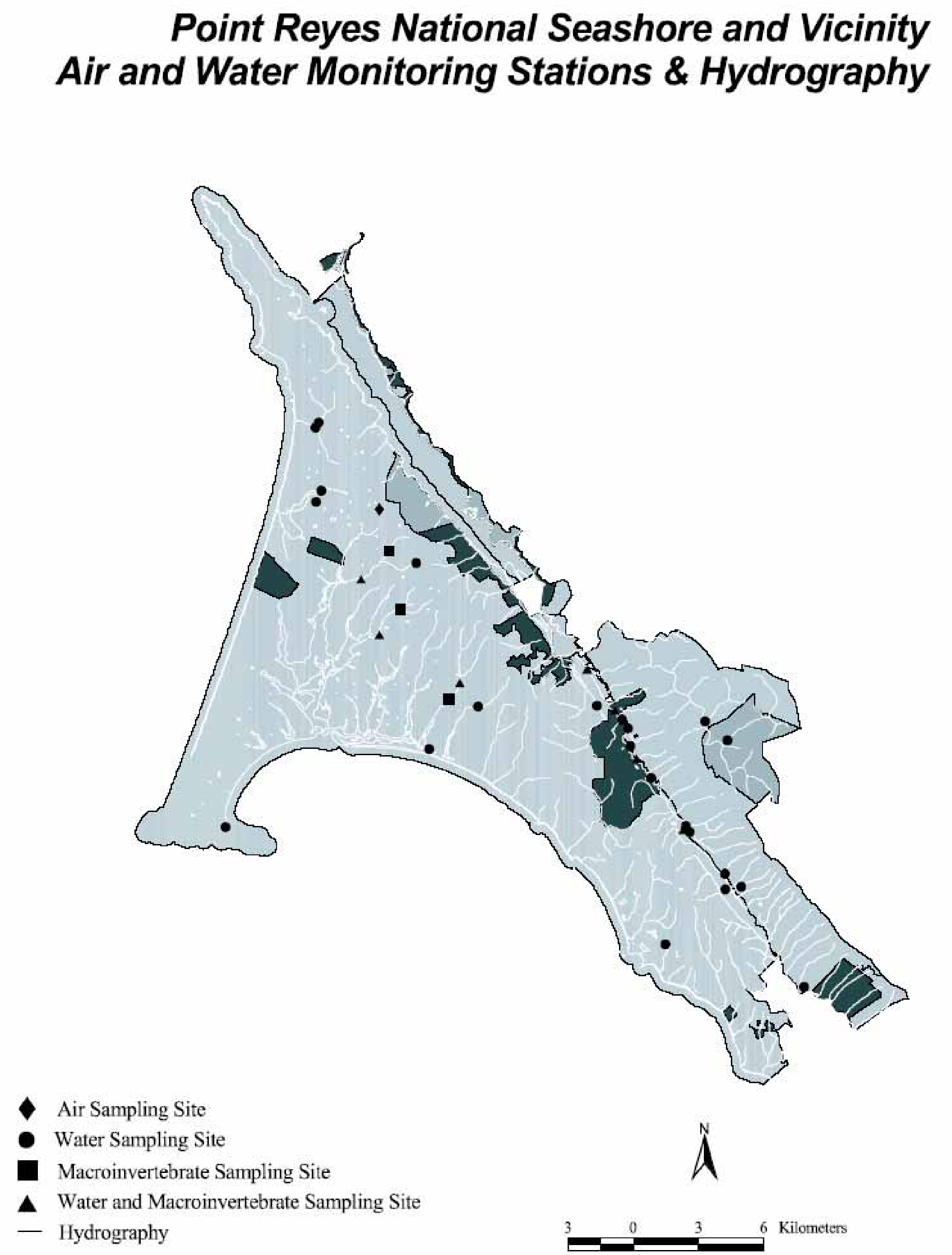

Figure VII-3. Hydrography of PORE. Also shown are the locations of air quality and water quality sampling sites monitored by the NPS.

Comment Letter 3. State Clearinghouse and Planning Unit, Sacramento, CA. Terry Roberts, Director.

STATE OF CALIFORNIA

Governor's Office of Planning and Research

State Clearinghouse and Planning Unit

Arnold Schwarzenegger
Governor

Jan Boel
Acting Deputy
Director

April 27, 2004

Don Newbacher
National Park Service
Point Reyes National Seashore
Point Reyes, CA 94956

Subject: Draft Fire Management Plan/EIS
SCH#: 2004024002

Dear Don Newbacher:

The State Clearinghouse submitted the above named Negative Declaration to selected state agencies for review. The review period closed on April 23, 2004, and no state agencies submitted comments by that date. This letter acknowledges that you have complied with the State Clearinghouse review requirements for draft environmental documents, pursuant to the California Environmental Quality Act.

Please call the State Clearinghouse at (916) 445-0613 if you have any questions regarding the environmental review process. If you have a question about the above-named project, please refer to the ten-digit State Clearinghouse number when contacting this office.

Sincerely,

Terry Roberts

Terry Roberts
Director, State Clearinghouse

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(916)445-0613 FAX(916)323-3018 www.opr.ca.gov

The letter received from the State Clearinghouse states that no comments were received from the list of state agencies that received a copy of the FMP/EIS by the close of the commenting period on April 20,2004. The Clearinghouse also notes that the PRNS FMP/EIS has complied with the review requirements of the California Environmental Quality Act (CEQA) for environmental documents.

Response to Letter 3. No response required.

Comment Letter 4: Board of the Inverness Ridge Association, Inverness, CA. Anthony Prud'homme, Director.

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Inverness Ridge Association
P.O Box 342
Inverness, CA 94937
April 3, 2004

Don Neubacher
Superintendent
Point Reyes National Seashore
Point Reyes, CA 94956
ATTN: FIRE MANAGEMENT PLAN

Dear Don:

The Board of the Inverness Ridge Association wishes to thank you and the PRNS staff for the fine work in developing a fire management plan for the Point Reyes National Seashore, and the Northern District of the Golden Gate National Recreation Area. Three members of the IRA Board (Bill Carlin, Anthony Prud'homme, and Mary Anne Warren) attended the March 18 workshop on the Draft Fire Management Plan Environmental Impact Statement, and found it to be both helpful and informative. We appreciate the opportunity to comment.

Of the three approaches discussed in the draft statement, we strongly support Alternative C, which is also the alternative preferred by the Park. Alternative C has many advantages, of which three appear to us to be salient.

Comment 4-1

The first advantage of Alternative C is that it permits fuel reduction to be done on up to 3,500 acres, as compared to 2,000 under Alternative B, the other option that is being seriously considered. We understand that Alternative C is estimated to permit the reduction of hazardous fuels to proceed at a rate that will accomplish a significant reduction in the risk of catastrophic fire within 13 years—as compared to 23 years under Alternative B. For those who live close to the park, this represents a substantial gain in safety, especially given the rapid regrowth in the areas burned in the 1995 Vision Fire. As we know from the work that we have done on our own properties, and in and around Paradise Ranch Estates—much of it with funding from the Wildland Urban Interface grants that the Park has generously provided—it is also more cost-effective, and produces a more aesthetically attractive result, if the regrowth areas are thinned before the Bishop pines become too large.

The second advantage of Alternative C is that it calls for more vegetation control (by mechanical methods only) along the Inverness Ridge Trail, from Limantour Road to the top of Mount Vision. For those of us in PRE, this is a crucial safety

1

Comment 4-1. The Inverness Ridge Association supports Alternative C, the preferred alternative of the NPS. Alternative C has three advantages:

> a) Permits fuel reduction on a greater amount of acres, thereby proceeding in the reduction of hazardous fuels at a more rapid rate and allows Bishop pine regrowth stands to be thinned while still small.
> b) Allows for more fuel reduction along the Inverness Ridge Trail, and
> c) The accelerated pace permitted under Alternative C allows the NPS and adjacent WUI communities to benefit from the current availability of federal funding for fire hazard reduction programs.

Response to Comment 4-1. Comment and preference noted.

Comment 4-1 continued

factor. Creating more defensible zones will greatly improve the chance of stopping fires in this area. We greatly appreciate the work that has already been done on the part of the Inverness Ridge Trail that is our emergency exit, from the end of Sunnyside Road to Limantour Road, and we support similar maintenance of the portion of the trail between the end of Sunnyside and the summit of Mount Vision. If this portion of the trail can be made more passable to emergency vehicles, this will also improve the odds of stopping a fire before it reaches PRE, Inverness, or Inverness Park.

The third advantage of Alternative C, which was noted at the March 18 workshop, is that federal funding appears to be available now for fire management projects in and around PRNS and GGNRA. Since this opportunity may be of limited duration, we think it desirable to proceed with all due speed. We are confident that the expertise of the PRNS staff will ensure that the work will be done without damage—indeed, with some gain—to the beauty of the landscape, and the health of native plant and animal species. In this regard, Ismael Gutierez and his crew are also a great resource, as they have become highly skilled and efficient in thinning vegetation with minimal disturbance to birds, animals, and endangered plants in the area.

Thank you again for all the time and thought that has gone into developing a fire management plan, informing the community about the alternatives under consideration, and requesting feedback.

Comment 4-2

Incidentally, we were pleased to learn that there will an e-mail list for those who wish to be informed about dates and locations for prescribed burns, and (with permission) we will let our members know how to get on the list.

Sincerely yours,

Anthony Prud'homme

Anthony Prud'homme, President
Inverness Ridge Association

Mary Anne Warren

Mary Anne Warren, Secretary
Inverness Ridge Asssociation

2

Comment 4-2. The membership of Inverness Ridge Association would like the opportunity to be apprised of the availability of email notification lists for prescribed burning.

Response to Comment 4-2. The Education Specialist for the Fire Program will continue to advertise the availability of the NPS email notification list notifying residents of upcoming fire management activities that could affect the local community, including the Inverness Ridge Association and other local homeowners' groups.

Comment Letter 5. Susan and John Van Der Wal, Inverness, CA.

SUSAN VAN DER WAL
PHOTOGRAPHER
P.O.BOX 264
315 VISION ROAD
INVERNESS, CALIFORNIA 94937-0264
TEL/FAX (415)669-7544
fax: (415)669-1739
email: jvdwal@svn.net

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April 19, 2004

Mr. Don L. Neubacher
Superintendent
Pt. Reyes National Seashore
Pt. Reyes Station, CA 94956

Attn: FIRE MANAGEMENT PLAN

Dear Superintendent Neubacher:

We have reviewed the DEIS for PRNS and the northern lands of GGNRA and have the following comments and concerns.

Comment 5-1

Pollution: Health reasons - the breathing of smoke hiking, our homes - outside during chores, enjoying our deck, windows open for the clear fresh air and airing house out on a daily basis. Constant days, weeks, months and years of this is very undesirable to say the least. It affects our communities as we all run errands. Noise from equipment on ground and planes and helicopters. We already have a major problem with the planes flying over the areas and all the parks. All this infringes on the solitude we all seek and one of many reasons most of us moved out here in the first place.

Comments 5-2 5-3 5-4

Aesthetics: The constant burning and even intermittantly does not solve the problems. Unsightly views of burned environment throughout the parks and roadway views; destroying non-native trees will eliminate shade for humans, wildlife and the habitat, nesting, etc, Wildlife needs bushes and use them for safety, shade, hunting, nesting (deer, elk bobcats, etc. leave young among these bushes which you will be destroying.) The burned environment only gets green after alot of rain which is winter time. We are very concerned about the effect of such a plan to the wildlife. We want to hear, see the many varied birds in the grasslands, trees, bushes not less no matter non-native, We love the whole feel and experience of our many hikes to Wittenberg and loops, Estero, Greenpicker to Pirtop, etc. We are not keen on "experimental-pilot burns" either. While protecting private property has its merits, we see the forest, removing under-brush has become excessive& taking away individual privacy. Using the private property" as an excuse for other motives. There is alot of hyperbole and the attempt to force fear into the public - works the opposite with us.

We chose to live here for the woods with the variety of trees and natural untouched beauty and the parks bordering our village of Inverness. We have been here for 22 years and are well aware there are risks living in such environment. But life is full of risk. We had one fire and the

(over)

Comment 5-1. Fire management actions will generate smoke, a health hazard, and increase noise from ground equipment and aircraft used in fire response.

Response to Comment 5-1. Prescribed burning does generate smoke but under conditions meeting the criteria of the Bay Area Air Quality Management District. Smoke generation is a short-term impact, lasting the duration of active prescribed fire and is localized in effects. Smoke generation would have greatest effects when prescribed burning is conducted in close proximity to residential areas. The primary residential areas adjacent to park lands are the Bolinas mesa and Paradise Ranch Estates. The BAAQMD requires a Smoke Management Plan for all prescribed fire as a means to assess potential affects of the fire on air basin air quality and potential health effects of smoke on adjacent residents. In conformance with BAAQMD requirements, the SMP includes the following project information:

- location and specific objectives of each proposed bum;
- acreage, tonnage, type, and arrangement of vegetation to be burned;
- directions and distances to nearby sensitive receptor areas;
- fuel condition, combustion and meteorological prescription elements for the project;
- projected bum schedule and expected duration of project ignition, combustion, and bum down
- (hours or days);
- specifications for monitoring and of verifying critical parameters including meteorological
- conditions and smoke behavior before and during the bum;
- specifications for disseminating project information to public;
- contingency actions that will be taken during the burn to reduce exposure if smoke intrusions impact any sensitive receptor area;
- certification by a qualified professional resource ecologist, biologist, or forester that the proposed burning is necessary to achieve the specific management objective(s) of the plan;
- a copy of the environmental impact analysis prepared for the plan that includes an evaluation of alternatives to burning, if such an analysis was required by state or federal law or statute;
- project fuel loading estimate (tons vegetation/acre) by vegetation type(s) and a description of thecalculation method; and
- particulate matter emissions estimate including referenced emission factor(s) and a description of the calculation method used. (BAAQMD, Regulation 5, Open Burning, Section 408).

The Draft EIS addressed the impacts of smoke on air quality and on human health on pages 232, and 395-396 (Alternative A), pages 236 and 398 (Alternative B) and pages 240 and 400 (Alternative C). Impacts from increased noise generated by heavy equipment and chainsaws, particularly during suppression actions is addressed on page 380-384 (Alternative A), 385-386 (Alternative B) and 387-389 (Alternative C). The FMP does not propose use of aircraft. Noise generation from aircraft would occur as part of wildfire suppression actions that could occur with or without the FMP and is not an effect of the FMP.

Comment 5-2. Prescribed burning will leave areas looking unsightly until the rains.

Response to Comment 5-2. The assessment is accurate. Given the potential for a large-scale wildfire to drastically alter the park setting, prescribed burning resulting in scattered areas of blackened acreage that revegetates quickly would be preferable to the effects of hotter, more damaging wildfire that would burn indiscriminately altering sensitive viewsheds. Areas subject to prescribed fire would appear blackened until regrowth occurs with winter rains. These short-term, moderate, adverse impacts are described for the three alternatives on pages 380-381 (Alternative A), page 385 (Alternative B) and page 387 (Alternative C).

Comment 5-3. Removing non-native vegetation will eliminate shade for humans and animals alike, remove screening understory vegetation and valuable habitat provided by the understory.

Response to Comment 5-3. As discussed in the Draft EIS, mechanical removal and prescribed burning of understory vegetation would have both adverse and beneficial short-term impacts on wildlife. Certain species, such as woodrats, may be attracted to temporarily stockpiled vegetation debris and displaced later during pile burning. Other wildlife species, such as deer, could benefit from improved foraging in clearings. In addition, the project actions themselves, involving vehicles and chainsaws among other equipment, would generate noise and locally disturb wildlife in the vicinity of projects over the short-term. Discussion of impacts of fire management actions on wildlife is addressed on pages 302 to 316. Impacts to special status wildlife species, in addition to special status plant species, are discussed on pages 323 through 368.

Comment 5-4. Commenters are not in favor of experimental pilot burns; reducing understory brush takes away individual privacy. The potential fire hazard has been exaggerated.

Response to Comment 5-4. As described on Draft EIS pages 87-89, recurring wildfires are part of the ecology of the Point Reyes peninsula. It's true that the degree of fire hazard varies throughout the year, but the Vision Fire and other conflagrations in the Bay Area have shown that extreme fire hazard conditions can develop in late summer and early fall.

parks,agencies involved go ballistic!

Comment 5-5

We are concerned about the exact location of those "staging areas" and "fire barriers" which involve construction/destruction and the visibility factor.

Comment 5-6

The report refers to "visitors experience" but what about the locals who live and work here and the communities experience? You can't imagine how visitors reactions to burning and other noises relating to Fire Management Plan have on their visits. Many people do get out of their cars, hike, picnic,etc. We certainly would not encourage anyone to come out here with the burning and other activities pertaining to the plan. We experienced first hand a control burn gone out of control at Banff National Park, Canada during the height of the summer(best weather) and tourist season. It was terrible and in such a gorgeous area - smoke and noises constant - so much for seeing the Canadian Rockies in clear blue sky. A real stupid plan by Canadian officials.Your plan calls for burning/mechanical treatment on weekdays (for the locals)and no .workweekends/holidays(for the visitors and Bay Area visitors). Many tourist come out weekdays simple because they are traveling from out of state/country and many visitors come weekdays to avoid the crowded weekends. The public doesn't really know how massive Alternative B/C are and many people do not want to express any thoughts on the Plan publicly for fear they would be looked upon as anti-fire management. We aren't either but,find the B/C and particuarly C is too massive and very aggressive which is what you want. We prefer Alternative A - no more action.

Reviewing the DFMP/EIS was most educational and very thorough, tine consuming and costly. It's our second such review report this year - the other was Tomales Bay State Park.

Thank you for the opportunity to comment on the Plan.

Sincerely,

Susan Van Der Wal

Susan Van Der Wal

John Van Der Wal

sk/

We may be contacted by e-mail(front page of this letter). The local post offices are best for fire burn days notices. We do not go daily to the Bovine Bakery which is open daily.

Comment 5-5. Commenters are concerned about the exact location of areas where disturbance would occur such as staging areas and fire lines around prescription burns.

Response to Comment 5-5. The FMP has a broad focus and does not identify the location of specific projects but rather ways to mitigate the effects of specific future projects by reducing the level of affect on soils, vegetation and viewshed by careful siting. For example, on Draft EIS page 58, under Mitigation Measure W-3, helispots, staging areas, and spike camps would be located at least 100 feet away from streams, creeks, and other water bodies. Measure V-1 requires that existing roads or trails be used as firebreaks for prescribed burns and for wildland fire suppression whenever possible in order to reduce disturbance, vegetation removal and aesthetics effects. Additional measures to rehabilitate lands disturbed by project actions are found on pages 55 through 59. All specific projects would be assessed for conformance with the guidelines and mitigation measures described in the Draft EIS.

Comment 5-6. The FMP DEIS should consider the affects of fire management actions on nearby residential communities as well as the visitor experience.

Response to Comment 5-6. Both the Draft and Final FMP addresses the effects of fire management actions on residential neighborhoods as part of the air quality assessment (localized smoke effects), impacts to visitor use and visitor experience (noise and visual effects) and public health and safety (smoke inhalation).

Comment 5-7. The Commenters prefer Alternative A; annual acreage amounts under Alternatives B and C are too large.

Response to Comment 5-7. Comment and preference noted.

Comment Letter 6. Department of Commerce, National Oceanic and Atmospheric Administration, National Marine Fisheries Service. Rodney R. McInnis, Acting Regional Administrator

L7617
FMP

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National Seashore
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PERSONNEL

UNITED STATES DEPARTMENT OF COMMERCE
National Oceanic and Atmospheric Administration
NATIONAL MARINE FISHERIES SERVICE
Southwest Region
501 West Ocean Boulevard, Suite 4200
Long Beach, California 908024213

May 17, 2004

In Response Refer To:
151422SWR04SR9246:PJ

Don L. Neubacher
Superintendent
Point Reyes National Seashore
Point Reyes, CA 94956

cc - W. Prost

Dear Mr. Neubacher:

Thank you for your letter requesting concurrence with your determination that the actions proposed in the Point Reyes National Seashore (PRNS) Fire Management Plan may affect, but are not likely to adversely affect Central California Coast (CCC) coho salmon *(Oncorhynchus kisutch)* and CCC steelhead (*O. mykiss*). In addition, the PRNS has determined that the proposed action is not likely to destroy or adversely modify critical habitat designated for CCC coho salmon. The PRNS has also determined that the project will not adversely affect Essential Fish Habitat (EFH) as designated under the Magnuson-Stevens Fishery Conservation and Management Act (MSFCM) for Pacific salmon, including coho salmon and Chinook salmon.

The PRNS proposes a framework for all fire management activities, including wildfire suppression, on land managed by PRNS and the Northern Districts of Golden Gate National Recreation Area. The seashore and the recreation area are located along the California coast within Marin County. The fire management plan is anticipated to guide the fire management program for the next 10 to 15 years. Information on proposed management activities and potential effects to salmonids have been provided to the National Marine Fisheries Service (NOAA Fisheries) by the Draft Environmental Impact Statement, consultation initiation letter, and through oral communication with PRNS staff.

Endangered Species Act. (ESA)

Comment 6-1

Based on the information provided, I concur with PRNS that the project as proposed is not likely to adversely affect threatened CCC steelhead, CCC coho salmon, or destroy or adversely modify critical habitat designated for CCC coho salmon. This concludes consultation for the PRNS Fire Management Plan in accordance with 50 CFR section 402.14(b)(1). However, if new information becomes available indicating that listed species may be adversely affected by the project in a manner not previously considered, or if the project plans change, further consultation may be necessary.

Comment 6-1. The National Marine Fisheries Service (NMFS) concurs that the project as proposed is not likely to adversely affect threatened fish species or adversely modified critical fish habitat. If the project plans change or new information on the listed species indicates a potential adverse effect, further consultation may be necessary.

Response to Comment 6-1. The following text for mitigation measure SS-7 is added to the FMP Final EIS.

SS-7 The annual work plan for FMP implementation will be provided to NOAA Fisheries each year to allow that agency to monitor the types of project proposed.

-2-

Magnuson-Stevens Fishery Conservation and Management Act

Amendments to the MSFCMA in 1996 require Federal agencies to consult with NOAA Fisheries regarding any action or proposed action that may adversely affect EFH for Federally-managed fish species. For more information on EFH, see our website at "http://swr.nmfs.noaa.gov."

Comment 6-2

NOAA Fisheries has evaluated the proposed project for potential adverse effects to EFH pursuant to section 305(b)(2) of the MSFCMA. The area affected by the project is part of EFH designated by the Pacific Fisheries Management Council for Pacific Salmon. Based on the information provided by PRNS, EFH Conservation Recommendations are not necessary. However, if the proposed action is modified in a manner that may adversely affect EFH, PRNS will need to reinitiate EFH consultation with NOAA Fisheries.

If you have any questions concerning this consultation, please contact Mr. Peter Johnsen at (707) 468-4063.

Sincerely,

Rodney R. McInnis
Acting Regional Administrator

cc: Jim Lecky, NOAA Fisheries

Comment 6-2. NMFS administers section 305(b)(2) of the Magnuson-Stevens Fishery Conservation and Management Act requiring federal agencies to consult with NMFS regarding the potential of projects to adversely affect “essential fish habitat.” The project area is part of the EFH for Pacific Salmon. The FMP as proposed does not require conservation recommendations but if the proposed work plan is modified, PRNS will need to reinitiate consultation with NMFS.

Response to Comment 6-2. See response to Comment 6-1.

Comment Letter 7. Environmental Action Committee of West Marin. Catherine Caufield, Executive Director.

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The Environmental Action Committee *of* West Marin

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ASST. SUPT.
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LAW ENFORC.
RES./SCIENCE
RANGE CONS.
FIRE MGT.
INTERP.
CULT. RES.
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CONTRACTING
PERSONNEL
BUDGET
CENTRAL FILES

cc Poirrot

May 11,2004

Superintendent Don Neubacher
Point Reyes National Seashore
Point Reyes Station, CA 94956

RE: Draft Fire Management Plan Environmental Impact Statement. Point Reyes National Seashore and North District of Golden Gate National Recreation Area

Dear Superintendent Neubacher,

The Environmental Action Committee of West Marin is very impressed with the detail of your presentation in the Draft Fire Management Plan. Having reviewed the plan, we believe that the Preferred Alternative (Alternative C) is the best one.

The Preferred Alternative works well with the community fire protection actions that EAC outlined in the 1996 Phoenix Report, and also with our other goals of protection and enhancement of biological diversity, containment of spread of invasive exotic plants and promoting practical research opportunities.

EAC also suggests that NPS coordinate with Tomales Bay State Park in its fire management planning efforts, as they are outlined in the Draft TBSP General Plan.

We hope that the National Park Service can continue to be a leader in the implementation of projects that reduce the threats to the environment that result from catastrophic wildfires. We are pleased to support Point Reyes National Seashore in its efforts to restore the ecological role of fire.

Thank you for the opportunity to comment.

Sincerely,

Catherine Caufield
Executive Director

Box 609, Point Reyes Station, California 94956 tel: 415-663-9312 fax: 415-663-8014 eac@svn.net

Comment 7-1. Commenter expresses preference for the Preferred Alternative.

Response to Comment 7-1. Comment and preference noted.

Comment 7-2. Commenter recommends NPS coordinate fire management planning efforts with Tomales Bay State Park as outlined in the Draft TBSP General Plan.

Response to Comment 7-2. Comment noted. The NPS has cooperated with Tomales Bay State Park through the federal Wildland Urban Interface Program and will continue to work cooperatively with State Parks to reduce fire hazards in West Marin.

Appendix A: Glossary of Terms and Acronyms

NEPA TERMINOLOGY

The controlling definitions for terms under CEQ's NEPA regulations are contained at 40 CFR. The numbers in parentheses refer to the appropriate section of 40 CFR. These definitions are provided as a supplement to those regulatory definitions.

Categorical exclusion (CE) (1508.4)—An action with no measurable environmental impact which is described in one of the categorical exclusion lists in section 3-3 or 3-4 and for which no exceptional circumstances (section 3-5) exist. NPS also uses the acronym "CX" to denote a categorical exclusion.

Connected actions (1508.25)—Actions that are closely related. They automatically trigger other actions that have environmental impacts, they cannot or will not proceed unless other actions have been taken previously or simultaneously, or they are interdependent parts of a larger action and/or depend on the larger action for their justification.

Conservation planning and impact assessment—Within NPS, this process is synonymous with the NEPA process. This process evaluates alternative courses of action and impacts so that decisions are made in accord with the conservation and preservation mandate of the NPS Organic Act.

Cooperating agency (1508.5)—A federal agency other than the one preparing the NEPA document (lead agency) that has jurisdiction over the proposal by virtue of law or special expertise and that has been deemed a cooperating agency by the lead agency. State or local governments, and/or Indian tribes, may be designated cooperating agencies as appropriate (see 1508.5 and 1502.6).

Cultural resources (NPS-28, Appendix A)—Aspects of a cultural system that are valued by or significantly representative of a culture or that contain significant information about a culture. A cultural resource may be a tangible entity or a cultural practice. Tangible cultural resources are categorized as districts, sites, buildings, structures, and objects for the National Register of Historic Places, and as archeological resources, cultural landscapes, structures, museum objects, and ethnographic resources for NPS management purposes.

Cumulative actions (1508.25)—Actions that, when viewed with other actions in the past, the present, or the reasonably foreseeable future, regardless of who has undertaken or will undertake them, have an additive impact on the resource the proposal would affect.

Cumulative impact (1508.7)—The impacts of cumulative actions.

Direct effect (1508.8)—An impact that occurs as a result of the proposal or alternative in the same place and at the same time as the action.

Environmental assessment (EA) (1508.9)—A brief NEPA document that is prepared to (a) help determine whether the impact of a proposal or alternatives could be significant; (b) aid NPS in compliance with NEPA by evaluating a proposal that will have no significant impacts, but that may have measurable adverse impacts; or (c) evaluate a proposal that either is not described on the list of categorically excluded actions, or is on the list but exceptional circumstances (section 3-5) apply.

Environmental impact statement (EIS) (1508.11)—A detailed NEPA document that is prepared when a proposal or alternatives have the potential for significant impact on the human environment.

Environmental screening process—The analysis that precedes a determination of the appropriate level of NEPA documentation. The minimum requirements of the environmental screening process are a site visit, consultation with any agency that has jurisdiction by law or special expertise, and the completion of a screening checklist. The process must be complete for all NPS actions that have the potential for environmental impact and are not described in section 3-3.

Environmentally preferred alternative (1505.2, Q6a)—Of the alternatives analyzed, the one that would best promote the policies in NEPA section 101. This is usually selected by the IDT members. It is presented in the NPS NEPA document (draft and final EIS or EA) for public review and comment.

Exceptional circumstances—Circumstances that, if they apply to a project described in the NPS categorical exclusion lists (sections 3-3 and 3-4), mean a CE is inappropriate and an EA or an EIS must be prepared because the action may have measurable or significant impacts. Exceptional circumstances are described in section 3-5.

Finding of no significant impact (FONSI) (1508.13)—A determination based on an EA and other factors in the public planning record for a proposal that, if implemented, would have no significant impact on the human environment.

Human environment (1508.14)—Defined by CEQ as the natural and physical environment, and the relationship of people with that environment (1508.14). Although the socioeconomic environment receives less emphasis than the physical or natural environment in the CEQ regulations, NPS considers it to be an integral part of the human environment.

Impact topics—Specific natural, cultural, or socioeconomic resources that would be affected by the proposed action or alternatives (including no action). The magnitude, duration, and timing of the effect to each of these resources is evaluated in the impact section of an EA or an EIS.

Indirect impact (1508.8)—Reasonably foreseeable impacts that occur removed in time or space from the proposed action. These are "downstream" impacts, future impacts, or the impacts of reasonably expected connected actions (e.g., growth of an area after a highway to it is complete).

Issues—In NEPA, issues are environmental, social, and economic problems or effects that may occur if the proposed action or alternatives (including no action) are implemented or continue to be implemented.

Lead agency (1508.16)—The agency either preparing or taking primary responsibility for preparing the NEPA document.

Major federal action (1508.18)—Actions that have a large federal presence and that have the potential for significant impacts to the human environment. They include adopting policy, implementing rules or regulations; adopting plans, programs, or projects; ongoing activities; issuing permits; or financing projects completed by another entity.

Memo to file—A memo to the planning record or statutory compliance file that NPS offices may complete when (a) NEPA has already been completed in site-specific detail for a proposal, usually as part of a document of larger scope, or (b) a time interval has passed since the NEPA document was approved, but information in that document is still accurate.

Mitigated EA (Q40)—An EA that has been rewritten to incorporate mitigation into a proposal or to change a proposal to reduce impacts to below significance.

Mitigation (1508.20)—A modification of the proposal or alternative that lessens the intensity of its impact on a particular resource.

NEPA process—The objective analysis of a proposal to determine the degree of its environmental and interrelated social and economic impacts on the human environment, alternatives and mitigation that reduce that impact, and the full and candid presentation of the analysis to, and involvement of, the interested and affected public.

Notices of availability—Separate notices submitted to the *Federal Register* that the draft EIS and the final EIS are ready for distribution.

Notice of intent (1508.22)—The notice submitted to the *Federal Register* that an EIS will be prepared. It describes the proposed action and alternatives, identifies a contact person in NPS, and gives time, place, and descriptive details of the agency's proposed scoping process.

Preferred alternative (1502.14 (e))—The alternative an NPS decision-maker has identified as preferred at the draft EIS stage or EA. Identification of the preferred alternative helps the public focus its comments during review of the NEPA document.

Programmatic documents—Broader scope EAs or EISs that describe the impacts of proposed policy changes, programs, or plans.

Proposal (1508.23)—The stage at which NPS has a goal and is actively preparing to make a decision on one or more alternative means of accomplishing that goal. The goal can be a project, plan, policy, program, and so forth. NEPA begins when the effects can be meaningfully evaluated.

Record of decision (ROD) (1505.2)—The document that is prepared to substantiate a decision based on an EIS. It includes a statement of the decision made, a detailed discussion of decision rationale, and the reasons for not adopting all mitigation measures analyzed, if applicable.

Scoping (1508.25)—Internal NPS decision-making on issues, alternatives, mitigation measures, the analysis boundary, appropriate level of documentation, lead and cooperating agency roles, available references and guidance, defining purpose and need, and so forth. External scoping is the early involvement of the interested and affected public.

Tiering (1508.28)—The use of broader, programmatic NEPA documents to discuss and analyze cumulative regional impacts and define policy direction, and the incorporation by reference of this material in subsequent narrower NEPA documents to avoid duplication and focus on issues "ripe for decision" in each case.

ACRONYMS

CE	Categorical exclusion
CEF	Categorical exclusion form
CEQ	President's Council on Environmental Quality
CX	Categorical exclusion
DEC	Division Environmental Comment request issued by NPS Environmental Quality Division-WASO
DM	Departmental manual
DOI	Department of the Interior
EA	Environmental assessment
ECM	Environmental compliance memorandum
EIS	Environmental impact statement
EO	Executive order
EPA	Environmental Protection Agency
ER	Environmental Review issued by the Department of the Interior
ERM	Environmental review memorandum
ESA	Endangered Species Act
ESM	Environmental statement memorandum
ESF	Environmental screening form
EQD	Environmental Quality Division
FONSI	Finding of no significant impact
GGNRA	Golden Gate National Recreation Area
GMP	General management plan
IDT	Interdisciplinary team
NEPA	National Environmental Policy Act
NHPA	National Historic Preservation Act
NMFS	National Marine Fisheries Service (New name is NOAA Fisheries)
NOA	Notice of availability
NOI	Notice of intent
NPS	National Park Service
PORE	Point Reyes National Seashore
REO	Regional environmental officer
ROD	Record of decision
SSO	System support office

WASO Washington, D.C., Office of the National Park Service

FIRE TERMS AND DEFINITIONS

AFFIRMS. (Administrative and Forest Fire Information Retrieval and Management System): A user-oriented interactive computer program which permits entry of fire weather observations and fire weather forecasts and which computes danger indices.

Backing fire. A prescribed fire or wildfire burning into or against the wind or down the slope without the aid of wind.

BEHAVE. A refinement of the Fire Behavior Prediction System that allows development of customized fuel models that can access the Rothermel fire spread equation (Burgan and Rothermel 1984).

Blackline. Preburning of fuels, either adjacent to a control line before igniting a prescribed fire or along a roadway or boundary as a deterrent to human-caused fires. Blacklining is usually done in heavy fuels adjacent to a control line during periods of low fire danger to reduce pressure on holding forces; blackline denotes a condition in which there is no unburned fine fuel remaining.

Burning index (BI). A relative number related to the contribution that fire behavior makes to the amount of effort needed to contain a fire in a specified fuel type. Doubling the BI indicates twice the effort will be required to contain a fire in that fuel type as was previously required providing all other parameters are held constant.

Cold trail. Method of controlling a partly-dead fire edge by careful inspection and feeling with the hand to detect any fire and extinguishing it by digging out every live spot and trenching any live edge.

Complex fire management program. A program involving prescribed burning, in addition to wildland fire suppression.

Density. The number of individuals, usually by species, per unit area.

Fire behavior. The response of fire to its environment of fuel, weather, and terrain including its ignition, spread, and development.

Fire effects. Physical, biological, and ecological impacts of fire on the environment.

Fire effects monitoring. A process that allows managers to evaluate whether environmental goals and objectives are being achieved and to adjust prescriptions to achieve a desired range of effects on the biotic and physical environment. Fire effects monitoring does not necessarily prove cause-and-effect associations. However, such monitoring will indicate if specific prescribed burn objectives were met and help management assess long-term change in these fire management areas.

Fire hazard. A fuel complex, defined by volume, type condition, arrangement, and location, that determines the degree of ease of ignition and of resistance to control.

Fire intensity. A general term relating to the heat energy released in a fire.

Fire resistance. A botanical adaptation that results in a lower probability of being injured or killed by fire. (e.g., thick platy or corky bark, or buds protected by long needles).

Fire return interval. Length of time necessary for an area equal to the entire area of interest to burn; size of the area of interest must be clearly specified.

Fire monitoring. The systematic process of collecting and recording fire-related data, particularly with regards to fuels, topography, weather, fire behavior, fire effects, smoke, and fire location.

Fire weather. Weather conditions which influence fire ignition, behavior, and suppression.

Fireline. Generally, any cleared or treated strip used to control a fire's spread; more specifically, that portion of a control line from which flammable materials have been removed by scraping or digging to mineral soil.

Flame height. The average maximum vertical extension of flames at the leading edge of the fire front. Occasional flashes that rise above the general level of flames are not considered. This distance is less than the flame length if flames are tilted due to wind or slope.

Flame length. The distance between the flame tip and the midpoint of the flame depth at the base of the flame (generally the ground surface); an indicator of fire intensity.

Flammability. The relative ease with which a substance ignites and sustains combustion.

Fuel. The materials which are burned in a fire: duff litter, grass dead branch wood, snags, logs, stumps, weeds, brush, foliage, and to a limited degree, green trees.

Fuel break. Generally wide (10-1000 feet) strips of land on which native vegetation has been permanently modified so that fires burning into them can be more readily controlled. Some fuelbreaks contain firelines (e.g., roads, handlines) which can be quickly widened with hand tools or by burning out.

Fuel loading. Amount of dead fuel present on a particular site a given time; the percentage of fuel available for combustion changes with the season.

Fuel model. Simulated fuel complex for which all fuel descriptors required for the solution of a mathematical rate of spread model have been specified.

Hazardous fuels. Fuels that, if ignited, could threaten park developments, human life and safety, natural resources, or carry fire across park boundaries.

Head fire. A fire front spreading or ignited to spread with the gradient (downwind or upslope).

Human-caused fire. Any fire caused directly of indirectly by person(s).

Mean Fire Interval. Arithmetic average of all fire intervals determined, in years in a designated area during a specified time period; size of the area and the time period must be specified.

NFDRS. (National Fire Danger Rating System) Multiple index scheme designed to provide fire suppression and land management personnel with a systematic means of assessing various aspects of fire danger on a day-to-day basis.

NIFQS. (National Interagency Fire Qualification System) Fire management qualifications systems which describes for a particular large fire suppression organization the acceptable standards for experience, training, and physical fitness required for principal jobs within the system. NIFQS, when coupled with a large fire suppression organization, provides a complete system for fire management.

NIIMS. (National Interagency Incident Management System) Common command system designed to be used by any agency as a day-to-day operational procedure which can be expanded in scope to provide management for major single or multi-jurisdictional emergencies.

Natural fire. Any fire of natural origin (e.g., lightning, spontaneous combustion, volcanic activity).

Prescribed burning. The deliberate ignition of a fire in accordance with an established management plan to accomplish specific objectives under given prescriptions for weather and fuel conditions.

Prescribed fire. The skillful application of fire to natural fuels under conditions of weather, fuel moisture, soil moisture, etc., that will allow confinement of the fire to a predetermined area and at the same time will produce the intensity of heat and rate of spread required to meet certain overall objectives in the areas of silviculture, wildlife management, grazing, hazard fuel reduction, etc. The overall objective of prescribed fire is to employ fire scientifically to realize maximum net benefits with minimum damage and acceptable cost.

Presuppression. Activities undertaken in advance of fire occurrence to help ensure more effective fire suppression; includes over-all planning, recruitment and training of fire personnel, procurement and maintenance of firefighting equipment and supplies, fuel treatment, and creating, maintaining, and improving a system of fuelbreaks, roads, water sources, and control lines.

Prevention. All activities concerned with minimizing the incidence of wildfires.

Rate of spread. Relative activity of a fire in extending its horizontal dimensions, expressed as rate of increase of the perimeter, rate of increase in area, or rate of advance of its head, depending on the intended use of the information; generally in chains or acres per hour for a specific period in the fire's history.

Rehabilitation. The activities necessary to repair damage or disturbance caused by wildfire or the fire suppression activity.

Smoke Management. Application of knowledge of fire behavior and meteorological processes to minimize degradation of air quality during prescribed fires.

Smokechaser. Person whose principal function is fire suppression.

Suppression. All actions intended to extinguish or limit the growth of fires, regardless of the strategies and tactics chosen.

Timelag. Time necessary, under specified conditions, for a fuel particle to lose approximately 63% of the difference between its initial moisture content and its equilibrium moisture content. Providing conditions remain unchanged, a fuel will reach 95% of its equilibrium moisture content after 4 timelag periods.

Urban/Wildland Interface. Line, area, or zone where structures and other human development meets or intermingles with undeveloped wildland or vegetation fuels.

WIMS. (Weather Information Management System). This new computerized system will replace the current AFFIRMS program in 1992.

Wet line. A line of water, or water and chemical retardant, sprayed along the ground, and which serves as a temporary control line from which to ignite or stop a low-intensity fire.

Wildfire. Any fire occurring on wildland that is not meeting management objectives and thus requires a suppression response.

Appendix B:
List of Classified Structures

List of Classified Structures in Project Area

	Struct. #	LCS #	Structure Name	NR Status	Significance Level	Cond.	Park
1	BO1940	9234	Olema Lime Kilns	Entered - Documented	State	Good	PORE
2	BO1945	56471	Randall Ranch Olema-Bolinas Road	Undetermined	Not Evaluated	Fair	PORE
3	BO1950	56415	Hagmaier Ranch Main Residence	Determined Eligible - SHPO	State	Good	PORE
4	BO1951	56416	Hagmaier Ranch Manager's House	Determined Eligible - SHPO	State	Good	PORE
5	BO1952	56417	Hagmaier Ranch Old Milking Barn	Determined Eligible - SHPO	State	Good	PORE
6	BO1953	56418	Hagmaier Ranch North Shed	Determined Eligible - SHPO	State	Fair	PORE
7	BO1954	56419	Hagmaier Ranch South Shed	Determined Eligible - SHPO	State	Fair	PORE
8	BO1980	9264	Teixeira Ranch Main House	Determined Eligible - SHPO	State	Good	PORE
9	BO1981	9265	Teixeira Ranch Grade A Dairy	Undetermined	Local	Good	PORE
10	BO1982	9266	Teixeira Ranch Original Milking Barn	Determined Eligible - SHPO	Local	Fair	PORE
11	BO1983	22725	Teixeira Ranch Horse Barn	Undetermined	Local	Fair	PORE
12	BO1984	22727	Teixeira Ranch Foot Bridge	Undetermined	Local	Poor	PORE
13	BO1985	22728	Teixeira Ranch Bridge	Undetermined	Local	Good	PORE
14	BO1986	22729	Teixeira Ranch Garage/Shed	Undetermined	Not Evaluated	Fair	PORE
15	BO1987	22730	Teixeira Ranch Fuel Storage Shed	Undetermined	Not Evaluated	Fair	PORE
16	BO1988	22711	Teixeira Ranch Stock Shed	Undetermined	Not Evaluated	Fair	PORE
17	BO1989	56412	Teixeira Ranch Water Tank	Undetermined	Not Evaluated	Fair	PORE
18	BO1990	56413	Teixeira Ranch Small Shed	Undetermined	Not Evaluated	Fair	PORE
19	BO1991	56414	Teixeira Ranch Wood Shed	Undetermined	Not Evaluated	Poor	PORE
20	BO2040	56475	Marconi Station Transmitter Building	Undetermined	Not Evaluated	Fair	PORE
21	BO2041	56476	Marconi Station Hotel	Undetermined	Not Evaluated	Good	PORE
22	BO2042	56477	Marconi Station Cottage #1	Undetermined	Not Evaluated	Good	PORE
23	BO2043	56478	Marconi Station Cottage #2	Undetermined	Not Evaluated	Good	PORE
24	BO2044	56479	Marconi Station Tennis Court	Undetermined	Not Evaluated	Fair	PORE
25	BO2045	56480	Marconi Station Radio Tower Bases	Undetermined	Not Evaluated	Fair	PORE
26	BO2050	56481	RCA Station Transmitter Building	Undetermined	Not Evaluated	Good	PORE
27	BO2051	56482	RCA Station Service Station	Undetermined	Not Evaluated	Poor	PORE
28	BO2052	56483	RCA Station Power House	Undetermined	Not Evaluated	Fair	PORE
29	BO2053	56484	RCA Station Cooling Tower	Undetermined	Not Evaluated	Fair	PORE
30	BO2070	56474	Ingermann Ranch House	Determined Eligible - SHPO	State	Fair	PORE
31	BV1600	56405	W Ranch Milking Barn	Determined Eligible - SHPO	State	Good	PORE
32	BV1700	56406	W Ranch John Rapp House	Determined Eligible - SHPO	State	Good	PORE

	Struct. #	LCS #	Structure Name	NR Status	Significance Level	Cond.	Park
33	BV1740	56423	Bear Valley Dedication Plaque	Ineligible - Managed as Resource	Not Significant	Good	PORE
34	BV1741	56424	Bear Valley Phillip Burton Wilderness Plaque	Ineligible - Managed as Resource	Not Significant	Good	PORE
35	BV1742	56485	Morgan Horse Ranch Dedication Plaque	Ineligible - Managed as Resource	Not Significant	Fair	PORE
36	BV1750	57556	Kule Loklo	Ineligible - Managed as Resource	Not Significant	Fair	PORE
37	BV1751	56408	W Ranch Z Ranch Road	Determined Eligible - SHPO	State	Fair	PORE
38	BV1752	56409	W Ranch Old Pine Trail	Determined Eligible - SHPO	State	Fair	PORE
39	BV1815	56411	Z Ranch Water System	Determined Eligible - SHPO	State	Fair	PORE
40	BV1845	56433	Glen Ranch Road	Determined Eligible - SHPO	State	Fair	PORE
41	BV1865	56434	Wildcat Ranch Road	Determined Eligible - SHPO	State	Good	PORE
42	BV1890	56425	Bear Valley Clem Miller Grave	Ineligible - Managed as Resource	Not Significant	Good	PORE
43	HE0012	9227	Point Reyes Light Station Stairway and Winch	Entered - Documented	Contributing	Good	PORE
44	HE0013	56300	Point Reyes Light Station East Rainshed	Entered - Undocumented	Contributing	Poor	PORE
45	HE0014	16043	Point Reyes Light Station West Rainshed & Cistern	Entered - Documented	Contributing	Fair	PORE
46	HE0015	56301	Point Reyes Light Station Oil House	Entered - Documented	Contributing	Good	PORE
47	HE0016	9228	Point Reyes Light Station Fog Signal Equipment Bld	Entered - Documented	Contributing	Good	PORE
48	HE0017	9229	Point Reyes Light Station Keeper's Garage	Entered - Documented	Contributing	Good	PORE
49	HE0018	56302	Point Reyes Light Station East Water Tank	Entered - Undocumented	Contributing	Good	PORE
50	HE0020	56303	Point Reyes Light Station Weather Bureau Building	Entered - Undocumented	Contributing	Fair	PORE
51	HE0021	9231	Point Reyes Light Station Fuel and Paint Storage	Entered - Documented	Contributing	Fair	PORE
52	HE0022	9232	Point Reyes Light Station Pumphouse	Entered - Documented	Contributing	Fair	PORE
53	HE0023	56304	Point Reyes Light Station Trail to Old Fog Signal	Entered - Undocumented	Contributing	Poor	PORE
54	HE0024	56305	Point Reyes Light Station Fog Signal Building Ruin	Entered - Undocumented	Contributing	Poor	PORE
55	HE0025	9233	Point Reyes Light Station Lighthouse	Entered - Documented	State	Good	PORE

	Struct. #	LCS #	Structure Name	NR Status	Significance Level	Cond.	Park
56	HE0026	56306	Point Reyes Light Station Laundry Bldg Foundation	Entered - Undocumented	Contributing	Poor	PORE
57	HE0027	56307	Point Reyes Light Station Road to Gov't Landing	Determined Eligible - SHPO	State	Good	PORE
58	HE0028	56308	Point Reyes Light Station Scr 682 No. 1 Radar Site	Undetermined	Not Evaluated	Fair	PORE
59	HE0029	56309	Point Reyes Light Station Cart House Platform	Entered - Undocumented	Contributing	Fair	PORE
60	HE0030	56310	Point Reyes Light Station National Register Plaque	Ineligible - Managed as Resource	Not Significant	Good	PORE
61	HE0031	56299	Point Reyes Light Station Granite Survey Monument	Entered - Undocumented	Contributing	Good	PORE
62	HE0115	9240	Point Reyes Lifeboat Station Officer-In-Charge Res	Entered - Documented	Contributing	Good	PORE
63	HE0116	16044	Point Reyes Lifeboat Station Water Storage Tank #1	Entered - Documented	Contributing	Fair	PORE
64	HE0117	16045	Point Reyes Lifeboat Station Water Storage Tank #2	Entered - Documented	Contributing	Poor	PORE
65	HE0118	9235	Point Reyes Lifeboat Station One-Car Garage	Entered - Documented	Contributing	Fair	PORE
66	HE0119	9236	Point Reyes Lifeboat Station Pumphouse	Entered - Documented	Contributing	Good	PORE
67	HE0120	16046	Point Reyes Lifeboat Station Stone Faced Wall	Entered - Documented	Contributing	Good	PORE
68	HE0121	16047	Point Reyes Lifeboat Station Water Storage Tank #3	Entered - Documented	Contributing	Good	PORE
69	HE0122	16048	Point Reyes Lifeboat Station Water Storage Tank #4	Entered - Documented	Contributing	Good	PORE
70	HE0123	9237	Point Reyes Lifeboat Station Fire Pumphouse	Entered - Documented	Contributing	Good	PORE
71	HE0124	16049	Point Reyes Lifeboat Station Low Rock Wall	Entered - Documented	Contributing	Fair	PORE
72	HE0125	9238	Point Reyes Lifeboat Station Boathouse	Entered - Documented	National	Good	PORE
73	HE0126	9239	Point Reyes Lifeboat Station Three Stall Garage	Entered - Documented	Contributing	Good	PORE
74	HE0127	56311	Point Reyes Lifeboat Station Road	Entered - Undocumented	Contributing	Good	PORE
75	HE0128	56312	Point Reyes Lifeboat Station Fuel Tanks	Entered - Undocumented	Contributing	Fair	PORE
76	HE0129	56313	Point Reyes Lifeboat Station Concrete Walks	Entered - Undocumented	Contributing	Fair	PORE
77	HE0130	56314	Point Reyes Lifeboat Station Drake Plaque	Ineligible - Managed as Resource	Not Significant	Good	PORE
78	HE0131	56315	Point Reyes Lifeboat Station NHL Plaque	Ineligible - Managed as Resource	Not Significant	Good	PORE
79	HE0132	55741	36-foot Motor Lifeboat No. 36542	Entered - Documented	Contributing	Good	PORE

	Struct. #	LCS #	Structure Name	NR Status	Significance Level	Cond.	Park
80	HE0133	22267	Point Reyes Lifeboat Station Marine Railway	Entered - Documented	National	Poor	PORE
81	LI1519	56426	Clem Miller Environmental Education Center Plaque	Ineligible - Managed as Resource	Not Significant	Good	PORE
82	LI1535	56432	Point Reyes Old Coast Road	Determined Eligible - SHPO	State	Fair	PORE
83	PA0215	56331	A Ranch Calf Shed	Determined Eligible - SHPO	State	Fair	PORE
84	PA0216	56332	A Ranch Gates, Fences, Corrals	Determined Eligible - SHPO	State	Fair	PORE
85	PA0250	56333	B Ranch Old House	Determined Eligible - SHPO	State	Fair	PORE
86	PA0251	56334	B Ranch Creamery	Determined Eligible - SHPO	State	Poor	PORE
87	PA0252	56335	B Ranch Horse Barn	Determined Eligible - SHPO	State	Fair	PORE
88	PA0253	56336	B Ranch Old Milking Barn	Determined Eligible - SHPO	State	Fair	PORE
89	PA0254	56337	B Ranch Grade A Barn	Undetermined	Not Evaluated	Fair	PORE
90	PA0255	56338	B Ranch Shed 1	Determined Eligible - SHPO	State	Fair	PORE
91	PA0256	56339	B Ranch Shed 2	Determined Eligible - SHPO	State	Fair	PORE
92	PA0257	56340	B Ranch Shed 3	Determined Eligible - SHPO	State	Fair	PORE
93	PA0270	56341	B Ranch Gates, Corrals, Fences	Determined Eligible - SHPO	State	Fair	PORE
94	PA0320	22268	C Ranch Main House	Determined Eligible - SHPO	State	Good	PORE
95	PA0321	22269	C Ranch Old Milking Barn	Determined Eligible - SHPO	State	Fair	PORE
96	PA0322	22270	C Ranch Chicken House	Determined Eligible - SHPO	State	Poor	PORE
97	PA0323	56342	C Ranch Garage/Shed	Determined Eligible - SHPO	State	Fair	PORE
98	PA0324	56344	C Ranch Bunk House	Determined Eligible - SHPO	State	Poor	PORE
99	PA0329	56343	C Ranch Gates, Corrals, Fences	Determined Eligible - SHPO	State	Fair	PORE
100	PA0390	56345	D Ranch Old Ranch House	Determined Eligible - SHPO	State	Fair	PORE
101	PA0391	56346	D Ranch Old Creamery	Determined Eligible - SHPO	State	Poor	PORE
102	PA0392	56347	D Ranch Horse Barn	Determined Eligible - SHPO	State	Fair	PORE
103	PA0393	56348	D Ranch Old Milking Barn	Determined Eligible - SHPO	State	Fair	PORE
104	PA0394	56349	D Ranch Bunk House	Determined Eligible - SHPO	State	Fair	PORE
105	PA0395	56350	D Ranch Shed	Determined Eligible - SHPO	State	Fair	PORE

	Struct. #	LCS #	Structure Name	NR Status	Significance Level	Cond.	Park
106	PA0396	56351	D Ranch Old Garage	Determined Eligible - SHPO	State	Fair	PORE
107	PA0397	56352	D Ranch Grade A Milking Barn	Determined Eligible - SHPO	State	Good	PORE
108	PA0400	56354	D Ranch Fences, Corrals, Gates	Determined Eligible - SHPO	State	Fair	PORE
109	PA0460	56420	Drakes Beach 1946 Drake Monument	Ineligible - Managed as Resource	Not Significant	Good	PORE
110	PA0461	56421	Drakes Beach Drake Navigators Guild Monument	Ineligible - Managed as Resource	Not Significant	Fair	PORE
111	PA0462	56422	Drakes Beach Nova Albion Plaque	Ineligible - Managed as Resource	Not Significant	Good	PORE
112	PA0490	56356	E Ranch Old Milking Barn	Determined Eligible - SHPO	State	Fair	PORE
113	PA0498	56358	E Ranch Road	Determined Eligible - SHPO	State	Fair	PORE
114	PA0499	56359	E Ranch Fences, Gates, Corrals	Determined Eligible - SHPO	State	Fair	PORE
115	PA0530	56361	F Ranch Schooner Landing (Ruin)	Determined Eligible - SHPO	State	Poor	PORE
116	PA0531	56362	F Ranch Schooner Landing Road	Determined Eligible - SHPO	State	Poor	PORE
117	PA0600	56365	G Ranch Cemetery Hinrik Claussen Grave	Ineligible - Managed as Resource	Not Significant	Good	PORE
118	PA0601	56366	G Ranch Cemetery Agneta Claussen Grave	Ineligible - Managed as Resource	Not Significant	Fair	PORE
119	PA0602	56367	G Ranch Cemetery Christiane Claussen Grave	Ineligible - Managed as Resource	Not Significant	Fair	PORE
120	PA0603	56368	G Ranch Cemetery Capt. Peter Henry Claussen Grave	Ineligible - Managed as Resource	Not Significant	Fair	PORE
121	PA0604	56369	G Ranch Cemetery Claussen Graveyard Fence	Ineligible - Managed as Resource	Not Significant	Good	PORE
122	PA0605	56370	Life-Saving Service Cemetery Fred Carstens Grave	Ineligible - Managed as Resource	Not Significant	Fair	PORE
123	PA0606	56371	Life-Saving Service Cemetery John Korpala Grave	Ineligible - Managed as Resource	Not Significant	Fair	PORE
124	PA0607	56372	Life-Saving Service Cemetery Andrew Anderson Grave	Ineligible - Managed as Resource	Not Significant	Fair	PORE
125	PA0608	56373	Life-Saving Service Cemetery George Larson Grave	Ineligible - Managed as Resource	Not Significant	Poor	PORE

	Struct. #	LCS #	Structure Name	NR Status	Significance Level	Cond.	Park
126	PA0609	56374	Life-Saving Service Cemetery Unidentified Grave	Ineligible - Managed as Resource	Not Significant	Poor	PORE
127	PA0610	56375	Life-Saving Service Cemetery Fence	Ineligible - Managed as Resource	Not Significant	Fair	PORE
128	PA0690	9267	Home Ranch Main House	Determined Eligible - SHPO	State	Good	PORE
129	PA0691	9268	Home Ranch Milking Barn	Determined Eligible - SHPO	State	Fair	PORE
130	PA0693	9270	Home Ranch Hog and Hen House	Determined Eligible - SHPO	State	Fair	PORE
131	PA0694	9271	Home Ranch Wood Shed	Determined Eligible - SHPO	State	Good	PORE
132	PA0695	9272	Home Ranch Lee Murphy Residence	Undetermined	Not Evaluated	Good	PORE
133	PA0696	9273	Home Ranch Machine Shop	Determined Eligible - SHPO	State	Fair	PORE
134	PA0697	9274	Home Ranch Old Dairy House	Determined Eligible - SHPO	State	Poor	PORE
135	PA0698	9278	Home Ranch Dog Shed/Storage	Undetermined	Not Evaluated	Fair	PORE
136	PA0699	9279	Home Ranch Garage	Undetermined	Not Evaluated	Fair	PORE
137	PA0700	9280	Home Ranch Pumphouse	Undetermined	Not Evaluated	Fair	PORE
138	PA0701	9281	Home Ranch Granary/Shed	Determined Eligible - SHPO	State	Poor	PORE
139	PA0702	9282	Home Ranch Horse Barn	Determined Eligible - SHPO	State	Fair	PORE
140	PA0703	56427	Home Ranch Gates, Corrals, Fences	Undetermined	State	Fair	PORE
141	PA0720	56428	Home Ranch Old Point Reyes Road	Determined Eligible - SHPO	State	Fair	PORE
142	PA0721	56429	Home Ranch Glenbrook/New Albion Road	Determined Eligible - SHPO	State	Fair	PORE
143	PP0850	56400	M Ranch Horse Barn	Determined Eligible - SHPO	State	Fair	PORE
144	PP0851	56401	M Ranch Old Milking Barn	Determined Eligible - SHPO	State	Fair	PORE
145	PP0855	56402	M Ranch Gates, Corrals, Fences	Determined Eligible - SHPO	State	Fair	PORE
146	PP0856	56403	M Ranch Road	Determined Eligible - SHPO	State	Fair	PORE
147	PP0940	56390	L Ranch House	Determined Eligible - SHPO	State	Good	PORE
148	PP0941	56391	L Ranch Dairy House	Determined Eligible - SHPO	State	Fair	PORE
149	PP0942	56392	L Ranch Horse Barn	Determined Eligible - SHPO	State	Fair	PORE
150	PP0943	56393	L Ranch Calf Barn	Determined Eligible - SHPO	State	Fair	PORE
151	PP0944	56394	L Ranch Milking Barn	Determined Eligible - SHPO	State	Fair	PORE

	Struct. #	LCS #	Structure Name	NR Status	Significance Level	Cond.	Park
152	PP0945	56395	L Ranch Shed	Determined Eligible - SHPO	State	Poor	PORE
153	PP0946	56396	L Ranch Garage	Determined Eligible - SHPO	State	Fair	PORE
154	PP0947	56397	L Ranch East Barn	Undetermined	Not Evaluated	Fair	PORE
155	PP0955	56398	L Ranch Gates, Corrals, Fences	Determined Eligible - SHPO	State	Fair	PORE
156	PP0956	56399	L Ranch Road to Sacramento Landing	Determined Eligible - SHPO	State	Fair	PORE
157	PP1090	56389	Old Pierce Point Road	Determined Eligible - SHPO	State	Fair	PORE
158	PP1100	56387	Lairds Landing House	Determined Eligible - SHPO	State	Fair	PORE
159	PP1101	56388	Lairds Landing Shed	Determined Eligible - SHPO	State	Fair	PORE
160	PP1102	56386	Lairds Landing Road	Undetermined	Not Evaluated	Fair	PORE
161	PP1120	56379	I Ranch Old Milking Barn	Determined Eligible - SHPO	State	Good	PORE
162	PP1121	56380	I Ranch Creamery	Determined Eligible - SHPO	State	Good	PORE
163	PP1122	56381	I Ranch Main Residence	Determined Eligible - SHPO	State	Good	PORE
164	PP1123	56382	I Ranch Feed Shed	Determined Eligible - SHPO	State	Good	PORE
165	PP1134	56383	I Ranch Gates, Fences, Corrals	Determined Eligible - SHPO	State	Fair	PORE
166	PP1135	56384	I Ranch Road	Determined Eligible - SHPO	State	Fair	PORE
167	PP1220	9241	Pierce Ranch Main House	Entered - Documented	State	Good	PORE
168	PP1221	9242	Pierce Ranch Tank House	Entered - Documented	State	Good	PORE
169	PP1222	9243	Pierce Ranch Wash House	Entered - Documented	State	Good	PORE
170	PP1223	9244	Pierce Ranch School House	Entered - Documented	State	Good	PORE
171	PP1224	20000	Pierce Ranch School Outhouse	Entered - Documented	State	Good	PORE
172	PP1225	9245	Pierce Ranch Carriage Shed	Entered - Documented	State	Good	PORE
173	PP1226	9246	Pierce Ranch Carpenter Shop	Entered - Documented	State	Good	PORE
174	PP1227	9247	Pierce Ranch Blacksmith Shop	Entered - Documented	State	Good	PORE
175	PP1228	9248	Pierce Ranch McClure Calf Shed	Entered - Documented	State	Good	PORE
176	PP1229	9249	Pierce Ranch Hay Barn	Entered - Documented	State	Good	PORE
177	PP1230	9250	Pierce Ranch New Dairy House	Entered - Documented	State	Good	PORE
178	PP1231	9251	Pierce Ranch Horse Barn	Entered - Documented	State	Good	PORE

	Struct. #	LCS #	Structure Name	NR Status	Significance Level	Cond.	Park
179	PP1232	9252	Pierce Ranch Old Garage	Entered - Documented	State	Good	PORE
180	PP1233	9253	Pierce Ranch Old Wagon Shed	Entered - Documented	State	Good	PORE
181	PP1234	9254	Pierce Ranch Chicken House "A"	Entered - Documented	State	Good	PORE
182	PP1235	9255	Pierce Ranch Chicken House "B"	Entered - Documented	State	Good	PORE
183	PP1236	9256	Pierce Ranch Old Dairy House	Entered - Documented	State	Fair	PORE
184	PP1238	9257	Pierce Ranch Corrals and Fences	Entered - Documented	State	Fair	PORE
185	PP1239	9258	Pierce Ranch Cistern	Entered - Documented	State	Good	PORE
186	PP1240	56320	Pierce Ranch Lath House	Entered - Documented	State	Good	PORE
187	PP1241	56321	Pierce Ranch Road to White Gulch Landing	Entered - Documented	State	Fair	PORE
188	PP1242	56322	Pierce Ranch Road to Lower Pierce Ranch	Entered - Documented	State	Fair	PORE
189	PP1243	56323	Pierce Ranch Entrance Road	Entered - Documented	State	Good	PORE
190	PP1244	56324	Pierce Ranch Cattle Guard	Entered - Documented	State	Fair	PORE
191	PP1245	56325	Pierce Ranch Ruins of Schooner Landing	Determined Eligible - SHPO	State	Poor	PORE
192	PP1246	56326	Pierce Ranch Ruins of Quail Clubhouse	Determined Eligible - SHPO	State	Fair	PORE
193	PP1247	56327	Pierce Ranch Hog Shed Ruins	Determined Eligible - SHPO	State	Fair	PORE
194	PP1248	56328	Pierce Ranch Feed Storage House	Entered - Undocumented	State	Fair	PORE
195	PP1249	56319	Pierce Ranch Rock Wall Remains	Entered - Undocumented	State	Fair	PORE
196	PP1250	56318	Pierce Ranch National Register Plaque	Ineligible - Managed as Resource	Not Significant	Good	PORE
197	OV0101	10160	Wilkins Ranch Main House	Determined Eligible - SHPO	Local	Good	GOGA
198	OV0102	22277	Wilkins Ranch Granary	Determined Eligible - SHPO	Local	Fair	GOGA
199	OV0104	10163	Wilkins Ranch Creamery	Determined Eligible - SHPO	Local	Fair	GOGA
200	OV0105	10164	Wilkins Ranch Main Barn	Determined Eligible - SHPO	Local	Fair	GOGA
201	OV0106	10162	Wilkins Ranch Shed/Garage	Determined Eligible - SHPO	Local	Fair	GOGA
202	OV0107	10161	Wilkins Ranch Horse Barn	Determined Eligible - SHPO	Local	Fair	GOGA
203	OV0109	22278	Wilkins Ranch Bull House	Undetermined	Not Evaluated	Fair	GOGA
204	OV0111	22279	Wilkins Ranch Well House	Undetermined	Not Evaluated	Fair	GOGA

	Struct. #	LCS #	Structure Name	NR Status	Significance Level	Cond.	Park
205	OV0112	56444	Wilkins Ranch Fences, Gates, Corrals	Determined Eligible - SHPO	Local	Fair	GOGA
206	OV0113	56445	Wilkins Ranch Roads	Determined Eligible - SHPO	Local	Fair	GOGA
207	OV0501	10165	Randall Ranch Sarah Seaver Randall House	Determined Eligible - Keeper	Local	Fair	GOGA
208	OV0601	10167	Giacomini Ranch House	Determined Eligible - SHPO	Local	Good	GOGA
209	OV0602	22271	Giacomini Ranch Carriage House	Determined Eligible - SHPO	Local	Fair	GOGA
210	OV0603	22272	Giacomini Ranch Grade A Dairy	Determined Eligible - SHPO	Local	Fair	GOGA
211	OV0606	10169	Giacomini Ranch Horse Barn	Determined Eligible - SHPO	Local	Poor	GOGA
212	OV0607	10170	Giacomini Ranch Barn	Determined Eligible - SHPO	Local	Fair	GOGA
213	OV0608	10171	Giacomini Ranch Creamery	Determined Eligible - SHPO	Local	Fair	GOGA
214	OV0611	10172	Giacomini Ranch Wood Shed	Determined Eligible - SHPO	Local	Fair	GOGA
215	OV0612	56469	Giacomini Ranch Water Tank	Undetermined	Not Evaluated	Fair	GOGA
216	OV0613	56470	Giacomini Ranch Gates, Fences, Corrals	Determined Eligible - SHPO	Local	Fair	GOGA
217	OV0907	56468	Parsons Ranch Gates, Corrals, Fences	Determined Eligible - SHPO	Local	Fair	GOGA
218	OV0908	56446	Parsons Ranch Roads	Determined Eligible - SHPO	Local	Good	GOGA
219	OV1001	10177	Five Brooks Pinkerton Residence	Undetermined	Not Evaluated	Good	GOGA
220	OV1002	56461	Five Brooks Pinkerton Large Shed	Undetermined	Not Evaluated	Fair	GOGA
221	OV1003	56462	Five Brooks Pinkerton Tractor Shed	Undetermined	Not Evaluated	Fair	GOGA
222	OV1004	56463	Five Brooks Pinkerton Outhouse	Undetermined	Not Evaluated	Fair	GOGA
223	OV1005	56464	Five Brooks Pinkerton Pumphouse	Undetermined	Not Evaluated	Fair	GOGA
224	OV1201	10178	Stewart Ranch Main House	Determined Eligible - SHPO	Local	Good	GOGA
225	OV1202	22712	Stewart Ranch Shed Storage	Determined Eligible - SHPO	Local	Fair	GOGA
226	OV1204	22714	Stewart Ranch Carriage House	Determined Eligible - SHPO	Local	Fair	GOGA
227	OV1205	22715	Stewart Ranch House No. 3 "Squatters House"	Determined Eligible - SHPO	Local	Fair	GOGA
228	OV1207	56465	Stewart Ranch Laundry	Determined Eligible - SHPO	Local	Fair	GOGA
229	OV1208	56466	Stewart Ranch Gates, Fences, Corrals	Determined Eligible - SHPO	Local	Fair	GOGA
230	OV1210	22716	Stewart Ranch House No. 1	Determined Eligible - SHPO	Local	Fair	GOGA

	Struct. #	LCS #	Structure Name	NR Status	Significance Level	Cond.	Park
231	OV1211	22717	Stewart Ranch Equipment Shed/Shop	Undetermined	Not Evaluated	Fair	GOGA
232	OV1212	10179	Stewart Ranch Old Barn	Determined Eligible - SHPO	Local	Good	GOGA
233	OV1213	22718	Stewart Ranch Silo	Undetermined	Not Evaluated	Fair	GOGA
234	OV1214	22719	Stewart Ranch Barn/Stables	Determined Eligible - SHPO	Local	Good	GOGA
235	OV1217	22720	Stewart Ranch Grade A Barn	Determined Eligible - SHPO	Local	Fair	GOGA
236	OV1219	22721	Stewart Ranch Open Front Shed	Determined Eligible - SHPO	Local	Fair	GOGA
237	OV1220	22722	Stewart Ranch Water Storage Tank	Undetermined	Not Evaluated	Fair	GOGA
238	OV1505	10159	Truttman Ranch Grade A Dairy Barn	Determined Eligible - SHPO	Local	Fair	GOGA
239	OV1512	22284	Truttman Ranch Grain Shed	Undetermined	Not Evaluated	Fair	GOGA
240	OV1516	10152	Truttman Ranch Bunk House	Determined Eligible - SHPO	Local	Fair	GOGA
241	OV1520	10156	Truttman Ranch Hay Barn	Determined Eligible - SHPO	Local	Poor	GOGA
242	OV1530	56430	Truttman Ranch Fences, Gates, Corral	Determined Eligible - SHPO	Local	Good	GOGA
243	OV1531	56431	Truttman Ranch Roads	Determined Eligible - SHPO	Local	Good	GOGA
244	OV1600	10150	Olema Valley East Copper Mine	Undetermined	Not Evaluated	Fair	GOGA
245	OV1601	57571	Olema Valley Copper Mine Ruins	Undetermined	Not Evaluated	Fair	GOGA
246	OV1602	57572	Olema Valley Copper Mine Road	Undetermined	Not Evaluated	Fair	GOGA
247	OV1700	10151	Olema Valley West Copper Mine	Undetermined	Not Evaluated	Fair	GOGA
248	OV3001	56435	McIsaac Ranch Main House	Undetermined	Not Evaluated	Fair	GOGA
249	OV3002	56436	McIsaac Ranch Shafter House	Undetermined	Not Evaluated	Fair	GOGA
250	OV3003	56437	McIsaac Ranch Barn	Undetermined	Not Evaluated	Fair	GOGA
251	OV3004	56438	McIsaac Ranch Calf Barn	Undetermined	Not Evaluated	Poor	GOGA
252	OV3005	56439	McIsaac Ranch Shelter Shed	Undetermined	Not Evaluated	Fair	GOGA
253	OV3006	56440	McIsaac Ranch Water Tank	Undetermined	Not Evaluated	Fair	GOGA
254	OV3007	56441	McIsaac Ranch Roads	Undetermined	Not Evaluated	Fair	GOGA
255	OV3008	56442	McIsaac Ranch Gates, Corrals, Fences	Undetermined	Not Evaluated	Fair	GOGA
256	OV3009	56443	McIsaac Ranch Tocaloma Bridge	Undetermined	Not Evaluated	Fair	GOGA
257	OV3101	56447	Zanardi Ranch Main House	Undetermined	Not Evaluated	Good	GOGA
258	OV3102	56448	Zanardi Ranch Creamery/Dwelling	Undetermined	Not Evaluated	Fair	GOGA
259	OV3103	56449	Zanardi Ranch Old Milking Barn	Undetermined	Not Evaluated	Fair	GOGA
260	OV3104	56450	Zanardi Ranch Horse Barn	Undetermined	Not Evaluated	Fair	GOGA
261	OV3105	56451	Zanardi Ranch Shed Garage	Undetermined	Not Evaluated	Fair	GOGA
262	OV3106	56452	Zanardi Ranch Cooler Shed	Undetermined	Not Evaluated	Good	GOGA

	Struct. #	LCS #	Structure Name	NR Status	Significance Level	Cond.	Park
263	OV3107	56453	Zanardi Ranch Shed next to Garage	Undetermined	Not Evaluated	Fair	GOGA
264	OV3108	56454	Zanardi Ranch Large Shed	Undetermined	Not Evaluated	Fair	GOGA
265	OV3109	56455	Zanardi Ranch Shed at Roadside	Undetermined	Not Evaluated	Fair	GOGA
266	OV3110	56456	Zanardi Ranch Old Shed in Yard	Undetermined	Not Evaluated	Fair	GOGA
267	OV3111	56457	Zanardi Ranch Small House	Undetermined	Not Evaluated	Fair	GOGA
268	OV3112	56458	Zanardi Ranch 1923 Shed	Undetermined	Not Evaluated	Fair	GOGA
269	OV3113	56459	Zanardi Ranch Water Tank	Undetermined	Not Evaluated	Fair	GOGA
270	OV3114	56460	Zanardi Ranch Gates, Corrals, Fences	Undetermined	Not Evaluated	Fair	GOGA
271	OV3200	56472	Lagunitas Creek/Tomales Bay Railroad Grade	Undetermined	Not Evaluated	Fair	GOGA
272	OV3300	56473	Old Olema Trail	Undetermined	Not Evaluated	Fair	GOGA
273	OV8001	57587	Rogers Ranch Old Milking Barn	Undetermined	Not Evaluated	Fair	GOGA
274	OV8002	57588	Rogers Ranch Old Dairy House	Undetermined	Not Evaluated	Poor	GOGA
275	OV8003	57589	Rogers Ranch Wagon Shed	Undetermined	Not Evaluated	Fair	GOGA
276	OV8004	57590	Rogers Ranch Garage/Shed	Undetermined	Not Evaluated	Good	GOGA
277	OV8005	57591	Rogers Ranch Fire Truck Shed	Undetermined	Not Evaluated	Fair	GOGA
278	OV8006	57592	Rogers Ranch Gates, Corrals, Fences	Undetermined	Not Evaluated	Good	GOGA
279	OV9001	57593	McFadden Ranch Hay Barn	Undetermined	Not Evaluated	Good	GOGA
280	OV9002	57594	McFadden Ranch Grade A Barn	Undetermined	Not Evaluated	Good	GOGA
281	OV9003	57595	McFadden Ranch Old Dairy	Undetermined	Not Evaluated	Fair	GOGA
282	OV9004	57596	McFadden Ranch Garage	Undetermined	Not Evaluated	Good	GOGA
283	OV9005	57597	McFadden Ranch Shed	Undetermined	Not Evaluated	Fair	GOGA
284	OV9006	57598	McFadden Ranch Road	Undetermined	Not Evaluated	Good	GOGA
285	OV9007	57599	McFadden Ranch Gates, Fences, Corrals	Undetermined	Not Evaluated	Good	GOGA
286	TB3503	57574	Hamlet Lacey Cabin	Determined Eligible - SHPO	Local	Poor	GOGA
287	TB3504	57579	Hamlet Outhouses	Determined Eligible - SHPO	Local	Poor	GOGA
288	TB3505	57575	Hamlet Bean Cabin	Determined Eligible - SHPO	Local	Poor	GOGA
289	TB3506	57576	Hamlet Boat Ways	Determined Eligible - SHPO	Local	Poor	GOGA
290	TB3507	57577	Hamlet Storage Shed	Determined Eligible - SHPO	Local	Poor	GOGA
291	TB3510	57578	Hamlet Jensen House	Determined Eligible - SHPO	Local	Poor	GOGA
292	TB3511	57580	Hamlet South Fisherman's Cabin	Determined Eligible - SHPO	Local	Poor	GOGA
293	TB3513	57581	Hamlet Middle Fisherman's Cabin	Determined Eligible - SHPO	Local	Poor	GOGA
294	TB3515	57582	Hamlet North Fisherman's Cabin	Determined Eligible - SHPO	Local	Poor	GOGA
295	TB3521	57585	Hamlet Water Tank House	Determined Eligible - SHPO	Local	Fair	GOGA

	Struct. #	LCS #	Structure Name	NR Status	Significance Level	Cond.	Park
296	TB3522	57586	Hamlet Old County Road	Determined Eligible - SHPO	Local	Fair	GOGA
297	TB3523	57573	Hamlet Remains of Railroad Grade	Determined Eligible - SHPO	Local	Fair	GOGA

Appendix C: Other Projects Considered in Cumulative Impacts Analysis

Projects Included in the Cumulative Analysis of the FMP

- The proposed McClure dairy barn and resource enhancement project, located in the North District of Point Reyes NS, involves construction of an 81,000 square foot loafing barn and development of manure holding ponds to enhance water quality. The project would enhance the viability of the ranch and exclusionary fencing will increase natural resource protection in the project area. One housing unit will be added to the complex.

- The Pacific Coast Learning Center has been initiated in existing buildings in Olema Valley at the former Hagmaier Ranch. The site is used for office space, housing, and fire fighting and maintenance equipment. No new construction has occurred and park and visitor use has occurred on the site for over 20 years.

- Sewage systems upgrades have been conducted at one residential unit on NPS lands and three new systems in residential units are planned for this fiscal year. The three units are all located in upper Olema Valley. The NPS headquarters buildings are receiving a new sewage system.

- Riparian protection projects in Olema Valley for coho salmon and steelhead restoration. These projects include riparian exclusionary fencing on Blueline Creek, Giacomini Creek, Cheda Creek, and other tributaries. The park should receive funding in FY05 for additional creek restoration in the Limantour Beach area.

- The Giacomini Ranch Wetlands Restoration Project planning is underway. The project involves restoring to wetlands approximately 560 acres of grazed land. The property was purchase in 2000. The wetlands restoration will be completed in FY07 or FY08 after public review and the completion of an EIS.

- Cultural resource preservation projects have been conducted in the Olema Valley within the last five years. The historic bunkhouse at Truttman Ranch, northern Olema Valley, has been reroofed and rehabilitated. The Giacomini Ranch house, in southern Olema Valley, and main barn have received preservation treatments to ensure long-term preservation. In 1997, the main barn at the Wilkins Ranch was stabilized. The main barn at Truttman will be stabilized in FY2001.

- The MCI building in the North District of Point Reyes National Seashore is receiving rehabilitation and will provide office space for district rangers. Ranger staff will be moved from existing office. Fire staff will also use the office space. No additional construction will occur.

- The Point Reyes Hostel has developed a proposal for upgrading housing, a new sewage system, and for providing additional overnight lodging. The proposal will increase lodging capability from 44-52 persons. Housing for staff will increase from 2 to 4 units.

- The Red Barn at park headquarters has been rehabilitated for curatorial storage and classroom space. There will also be office space for existing Marine Sanctuary staff.

- An average of 20 Wildland Urban Interface projects per year are being conducted in conjunction with FireSafe Marin, Marin County Fire Department, and other community organizations. These projects are primarily vegetation treatments along roadways for evacuation routes, creation of defensible space around homes, and fuel load reductions in strategic areas.

- The Point Reyes Lighthouse has been rehabilitated by repairing key structures such as the stairway and other site features. The Lighthouse is receiving a new water system and buildings are being repaired and painted.

- The Historic Lifeboat Station is scheduled in FY05 to receive approximately $1.0 million to restore the boat launching facility. The project involves the rehabilitation of pilings and railway rescue boat launching structures.

- The Vision Fire, a large wildlife that occurred in October of 1995 was started by an illegal campfire, and burned approximately 12,500 acres and destroyed roughly 45 structures on Inverness Ridge.

Appendix D: Biological Opinion United States Fish and Wildlife Service

United States Department of the Interior

FISH AND WILDLIFE SERVICE
Sacramento Fish and Wildlife Office
2800 Cottage Way, Room W-2605
Sacramento, California 95825-1846

In reply refer to:
1-1-04-F-0181

May 28, 2004

Memorandum

To: Superintendent, Point Reyes National Seashore, National Park Service, Point Reyes Station, California

From: FOR ~~Acting~~ Acting Field Supervisor, Sacramento Fish and Wildlife Office, Sacramento, California Cliff Nagano

Subject: Formal Consultation on the Fire Management Plan, Point Reyes National Seashore and Golden Gate National Recreation Area in Marin County, California

This is in response to your April 1, 2004, request for formal consultation with the U.S. Fish and Wildlife Service (Service) on the Fire Management Plan at Point Reyes National Seashore and the Golden Gate National Recreation Area in Marin County, California. Your letter was received by this Field Office on April 5, 2004. This document represents the Service's review of the effects of the action on the endangered Myrtle's silverspot butterfly (*Speyeria zerene myrtleae*), endangered Sonoma alopecurus (*Alopecurus aequalis* var. *sonomensis*), endangered Sonoma spineflower (*Chorizanthe valida*), endangered Tiburon paintbrush (*Castilleja affinis* ssp. *neglecta*), endangered beach layia (*Layia carnosa*), endangered Tidestrom's lupine (*Lupinus tidestromii*), threatened Marin dwarf flax (*Hesperolinon congestum*), endangered California freshwater shrimp (*Syncaris pacificus*), threatened California red-legged frog (*Rana aurora draytonii*), threatened Pacific Coast Population of the western snowy plover (*Chardrius alexandrinus nivosus*), threatened northern spotted owl (*Strix occidentalis caurina*), and proposed critical habitat for the California red-legged frog. This biological opinion is issued pursuant to section 7 of the Endangered Species Act of 1973, as amended (Act).

The Service considers the protection of human life and safety to be of the utmost importance and highest priority; the Act contains provisions for conducting emergency actions that involve listed species (50 CFR § 402.05). We recommend the National Park Service review the Act and/or contact us for further details regarding these procedures.

This biological opinion is based on your April 1, 2004, letter, to the Service; *Draft Fire Management Plan Environmental Impact Statement Point Reyes National Seashore and North District of Golden Gate National Recreation Area* (DEIS) dated January 2004, that was prepared by the U. S. National Park Service; *Point Reyes National Seashore Threatened and Endangered Species Locations as of 2001*, undated, that was prepared by the National Park Service; a meeting between Robert Gerson and Chris Nagano of the Service, and you and your staff on March 3, 2004; a letter from the National Park Service to the Service dated April 28, 2004; and other information available to the Service.

The Service concurs with the determination by the National Park Service that the proposed project is not likely to adversely affect the Sonoma alopecurus, Sonoma spineflower, Tiburon paintbrush, beach layia, Tidestrom's lupine, Marin dwarf flax, California freshwater shrimp, and the Pacific Coast Population of the western snowy plover. This is because the proposed project will not be implemented in the areas or habitats utilized by these species, or because the specific measures described in the DEIS will result in the avoidance of adverse effects to these listed taxa.

The Service concurs with the determination that the proposed project is not likely to adversely affect the threatened northern spotted owl because of the avoidance measures that will be implemented by the National Park Service. The measures include the following:

1. National Park Service staff will annually identify and map areas where northern spotted owls are nesting.

2. To the greatest extent possible, National Park Service staff will protect occupied and previously used nest sites from unplanned ignitions.

3. Activities described in the Fire Management Plan, such as prescribed burning, mechanical treatment, debris chipping or other noise generating actions, will not occur within 0.40-kilometer (km)(0.25-mile) of a known occupied, or previously used northern spotted owl nest site between February 1 and July 31 (breeding season).

4. National Park Service staff will conduct post-treatment monitoring of owls to ascertain any impacts associated with the Fire management Plan.

5. Mechanical fuel reduction activities will not alter the percent cover of canopy overstory and will preserve a multi-layered structure according to the Fire Management Plan that states that 60% of the canopy cover will be preserved. Mechanical fuel reduction projects will be implemented to remove stands of flammable non-native tree and shrub species, and to strategically reduce overall fuel densities and ladder fuels in shaded fuel breaks. Mechanical fuel reduction activities may include cutting, chipping and burning of slash piles. Fuel reduction would be accomplished by removing a) non-native shrubs and trees (such as French broom, Scotch broom, Spanish broom, eucalyptus, black acacia, and green wattle acacia), b)

native shrubs with more flammable tendencies (such as coyote bush or chamise), and c) native trees greater than 25.4 centimeters (cm)(10 inches [in]) diameter at breast height only if the trees are dead or structurally unstable and within falling distance of homes, drives, roads or trails or other public use areas.

6. Fuel reduction actions to construct shaded fuel breaks will selectively remove vegetation to achieve a strategically sited, linear zone of reduced fuels. Multi-layered structure would be reduced but only within the width of the shaded fuel break and only to a height of 1.83 to 2.44 meters (m)(6 to 8 feet [ft]). Trees will be limbed up to 1.93 to 2.44 m (6 to 8 ft) from the ground to reduce overall ladder fuels and the potential for a ground fire to spread into the tree canopy. Typically a linear fuel break feature can range from 9.15 to 61 m (30 to 200 ft) wide and usually buffers a fire road, an interface with development, expands upon an area with existing low fuels, or other strategic feature that presents an opportunity to slow the spread of a fire.

The Service does not concur that the proposed project will result in effects to the threatened California red-legged frog, proposed critical habitat for the California red-legged frog, and endangered Myrtle's silverspot butterfly that will be insignificant, discountable, or entirely beneficial. However, based on our analysis, the Service has determined that the proposed project will result in significant long-term benefits to these two listed animals and the proposed critical habitat, and any adverse effects will minor and temporary in nature. This biological opinion analyses these effects of the project on the California red-legged frog, the proposed critical habitat for the California red-legged frog, and the Myrtle's silverspot butterfly.

Consultation History

March 1, 2004: Chris Nagano and Roberta Gerson of the Service met with Don Neubacher, Sara Allen, Roger Wong, Jane Rodgers, and Wendy Poinsot of the National Park Service regarding the proposed project.

March 4, 2004: Chris Nagano of the Service sent an e-mail to Sarah Allen of the National Park Service requesting additional information on the project.

March 4, 2004: Sarah Allen of the National Park Service sent information on the proposed project to Chris Nagano of the Service.

April 5, 2004: Sarah Allen of the National Park Service and Chris Nagano of the Service discussed the potential effects of the proposed project in the California red-legged frog, Myrtle's silverspot butterfly, and Sonoma Alopecurus.

April 28, 2004: Sarah Allen of the National Park Service sent information on the northern spotted owl to Roberta Gerson of the Service.

April 28, 2004: Sarah Allen of the National Park Service sent additional information on the northern spotted owl to Roberta Gerson of the Service.

May 24, 2004: The Service sent Point Reyes National Seashore and the Golden Gate National Recreation Area a draft of the biological opinion for their review and comment.

May 28, 2004: The National Park Service sent the Service comments and suggestions on the draft biological opinion.

BIOLOGICAL OPINION

Description of the Proposed Action

The purpose of the Fire Management Plan is to provide a framework for all fire management activities for Point Reyes National Seashore and the North District of the Golden Gate National Recreation Area, including suppression of unplanned ignitions, prescribed fire, and mechanical fuels treatments. It is intended to guide the Fire Management Plan for approximately the next 10-15 years. The plan includes concise program objectives, details on staffing and equipment, and comprehensive information, guidelines, and protocols relating to the management of unplanned wildfire, prescribed burning, and mechanical fuels treatment. The Fire Management Plan is described in detail in the DEIS.

Alternative C, the preferred alternative in the DEIS, and the alternative whose effects on listed species is analyzed in this biological opinion, would include increase reduction of hazardous fuels in high priority areas (e.g., along road corridors, around structures, and in strategic areas to create fuel breaks). According to the DEIS, up to 8648.5 hectares (ha)(3,500 acres) could be treated per year using prescribed fire and mechanical treatments. Page 106 of the DEIS states that there are a total of 52129.7 ha (21096.6 acres) in the Fire Management Units. Under Alternative C, research efforts would be expanded to determine the effects of fire on natural resources of concern (e.g., rare and non-native species) and to determine the effectiveness of various fuels treatments. Research results would be used adaptively to guide the Fire Management Plan in maximizing benefits to natural resources, while protecting lives and property.

Proposed Conservation Measures

Fuel reduction actions described in the DEIS would be implemented in conjunction with avoidance measures designed to minimize or avoid potential environmental effects to listed species. In many cases, specific avoidance measures have been developed for the protection of individual listed species. The following general avoidance measures have been developed and would be applied to each fire management action with potential to affect a listed species or its habitat:

1. To ensure that implementation of fire management plan actions conforms to findings of this impact assessment, subsequent fire year plans and individual projects would be subject to National Park Service project review. Prior to approval, all projects would be submitted through a National Park Service internal review process wherein an interdisciplinary team would evaluate if the potential effects of the proposed projects were adequately addressed through the Fire Management Plan National Environmental Quality Act process. Conformance to the conclusions in the Fire Management Plan Environmental Impact Statement will be documented for the National Environmental Quality Act record by a memorandum to the file. If the interdisciplinary team finds that the project has the potential for new environmental effects not addressed in the Environmental Impact Statement (EIS) or effects greater than those assessed in the EIS, a separate environmental process would be conducted.

2. Known populations of special-status plant and animal species would be monitored to ensure long-term impacts are avoided. Geographic information system maps of population locations will be kept current and available for consultation in case of uncontrolled wildland fire and for planning prescribed burns. To the extent possible, known populations of special status species would be avoided when locating fire lines, helispots or spike camps during wildfire suppression actions. If new populations are discovered or existing populations expanded, species-specific measures described in the DEIS will be applied. Similarly, new information will be incorporated through the individual project review process.

Species-Specific Conservation Measures for The Two Listed Species

Myrtle's Silverspot Butterfly

The DEIS includes a number of specific conservation measures for the endangered Myrtle's silverspot butterfly. During the pre-project analysis within the Tomales Fire Management Unit, the prescribed fire and mechanical treatment will include surveys for western dog violet (*Viola adunca*), the larvae foodplant, within grassland communities between March 1 and August 31. If the foodplant is found within proposed project areas, then surveys for adults will be done between July 1 and August 31 on a three-week rotation. If the surveys locate the butterfly, further analysis will be done to determine if the project can go forward without harassment to the species. The projects may be either cancelled or reconfigured to accommodate the species; burning and mechanical treatments will not occur during the flight season of Mrytle's silverspot buttefly (June 1 through August 31). The project will proceed if Myrtle's silverspot butterfly are not located during the surveys; additional monitoring will be conducted for *Viola adunca* and the listed animal. The project may go forward if *Viola adunca* is not found; burning and mechanical treatments will not occur during the flight season of the listed butterfly.

California Red-legged Frog

According to the DEIS, areas inhabited by the California red-legged frogs that will be treated by mechanical means or prescribed fire would have a buffer area of 9.15 m (30 ft) established around known breeding habitat. This buffer will be established 9.15-m (30-ft) from the outer edge of riparian vegetation.

Status of the Species

Myrtle's silverspot butterfly

Myrtle's silverspot butterfly was listed as an endangered species in 1992 (57 **FR** 27848). A detailed account of the taxonomy, ecology, and biology of the species is presented in the *Recovery Plan for Seven Coastal Plants and the Myrtle's Silverspot Butterfly* (Service 1998). This butterfly is one of four related coastal subspecies of *Speyeria zerene* that occur from Washington to California: the threatened Oregon silverspot buttefly (*Speyeria zerene hippolyta*), endangered Behrens' silverspot (*Speyeria zerene behrensii*), glorius silverspot (*Speyeria zerene gloriosa*) and Myrtle's silverspot. All three listed silverspot butterflies occupy restricted habitat types close to the coast, and have been seriously impacted by human activities.

Myrtle's silverspot butterfly inhabits coastal dunes, coastal prairie, and coastal scrub at elevations ranging from sea level to 300 m (1,000 ft), and as far as 5 kilometers (km)(3 miles) inland (Launer *et al.* 1992). The adult butterflies prefer areas protected from onshore winds, but can be observed in exposed areas when winds are calm.

Critical factors in the distribution of Myrtle's silverspot butterfly include presence of the presumed larval host plant, western dog violet, and availability of nectar sources for adults. Although alternate larval host plants have neither been confirmed nor ruled out for the Myrtle's silverspot butterfly, other subspecies of *Speyeria zerene* and other species of silverspot butterflies can feed on more than one species in the genus *Viola*. Seeds of *Viola* are often dispersed by ants. Violets sometimes bear self-pollinating flowers, and are also cross-pollinated by insects. Adult Myrtle's silverspot butterflies have been observed nectaring on non-native species such as bull thistle (*Cirsium vulgare*) and rarely Italian thistle (*Carduus pycnocephalus*). In dune scrub habitat, these butterflies seek nectar from several native species such as gum plant (*Grindelia* sp.), western pennyroyal (*Monardella undulata*), yellow sand verbena (*Abronia latifolia*), seaside daisy (*Erigeron glaucus*), and mule ears (*Wyethia* sp.). Other flowering plants that might serve as good nectar sources for the opportunistic adults, such as brownie thistle (*Cirsium quercetorum*) and groundsel (*Senecio* sp.). The related threatened Oregon silverspot butterfly has been observed to visit yarrow (*Achillea millefolium*), goldenrod (*Solidago* sp.), beach aster (*Aster chilensis*), the non-native rough cat's-ear (*Hypochaeris radicata*), and pearly everlasting (*Anaphalis margaritacea*).

Female Myrtle's silverspot butterflies lay their eggs singly on or near dried leaves and stems of violets. Within a few days after the eggs are laid, the larvae (caterpillars) hatch, feed on the lining of the egg, crawl a short distance into the surrounding foliage or litter, and spin a silk pad on which they spend the summer, fall, and winter. The period of inactivity is a resting state called diapause, during which time the animals do not feed. The larvae may be able to extend their diapause for more than one year. Upon termination of diapause in the spring, the caterpillar finds a nearby violet and begins feeding. Feeding may be difficult to observe, and occurs at dusk and possibly at night. The larval feeding stage lasts about 7–10 weeks, after which the larvae form their pupae within a chamber they make with leaves spun together with silk. The adult butterfly emerges from the pupa after about a few weeks or possibly months.

The flight season for Myrtle's silverspot butterfly extends from mid-June to early October (Launer *et al.* 1992), during this time period they mate, lay eggs, and die. Adult activity is closely tied to weather conditions: they are active during calm weather and inactive during windy periods. Both sexes are good flyers and can travel kilometers in search of nectar, mates, or violets. Following the flight season, eggs and active larvae are present for an additional week or two in the fall, and then the larvae then enter their diapause. The larvae resume activity and begin feeding at some point during the spring that varies depending on the weather.

Historically, Myrtle's silverspot butterfly was recorded from the north-central coast of California, including San Mateo County as far south as Pescadero (in 1950), north to the vicinity of Black Point in northern Sonoma County. By the late 1970s, populations of silverspot south of the Golden Gate Bridge were believed to be extinct and extant populations were known only from Marin County at the Point Reyes National Seashore. In 1990, an additional population was discovered at a site in northernmost coastal Marin County, on property proposed for a golf resort and residential development. The proposal for the golf course was withdrawn and later replaced with a proposal for low density residential development and open space at the same site. This site was estimated to support between 2,500 and 5,000 adult silverspots in 1991. Two apparently separate populations in Point Reyes National Seashore were estimated at less than 5,000 individuals and several hundred individuals, respectively, in 1993. No trends over time are discernable in the limited population data. In summary, this butterfly is currently known from three occurrences with a probable total of fewer than 10,000 individuals. Population sizes of the species can be expected to fluctuate widely.

The listing of the Myrtle's silverspot was based on its extirpation from the southern third of its historical range (south of the Golden Gate Bridge) and adverse effects of urban development, invasive non-native vegetation, livestock grazing, and other human influences throughout its range. Myrtle's silverspot butterfly occurs in separate populations whose long-term persistence may depend upon movement between populations. Habitat degradation resulting in the loss of intervening populations, larval food plants, and adult nectar sources may make movements between populations more difficult. Illegal collection is also a threat to Myrtle's silverspot. Specimens of Myrtle's silverspot butterfly are known to have been illegally collected in Point Reyes National Seashore. Illegal collection of adults is likely to continue at a level that is difficult to quantify. Substantial areas of habitat and potential habitat for Myrtle's silverspot are protected in the Point Reyes National Seashore and the northern unit of the Golden Gate National Recreation Area.

There are recent sightings of Myrtle's silverspot butterfly within the Tomales Point Fire Management Unit at Point Reyes National Seashore, although suitable habitat elsewhere at this National Park and possibly the Golden Gate National Recreation Area (California Department of Fish and Game 2004; DEIS; Service files). In addition, adult Myrtle's silverspot butterflies are highly mobile and, like other silverspot butterflies, may fly considerable distances (Nagano pers. obs). Suitable habitat is found in and adjacent to the action area. Areas of containing larvae and adult food sources exist within the action area. The action area contains components that can be used by Myrtle's silverspot butterfly for feeding, resting, mating, movement corridors, and other essential behaviors. Therefore, the Service believes that Myrtle's silvespot butterfly is reasonably certain to occur within the action area because of the biology and ecology of the animal, the presence of suitable food sources and habitat in and adjacent to the action area, as well as the recent observations of this listed species.

California red-legged frog

The California red-legged frog was listed as a threatened species on May 23, 1996, (61 **FR** 25813). Please refer to the final rule and the Recovery Plan for this animal for additional information. This species is the largest native frog in the western United States (Wright and Wright 1949), ranging from 4 to 13 cm (1.5 to 5.1 in) in length (Stebbins 1985). The abdomen and hind legs of adults are largely red; the back is characterized by small black flecks and larger irregular dark blotches with indistinct outlines on a brown, gray, olive, or reddish background color. Dorsal spots usually have light centers (Stebbins 1985), and dorsolateral folds are prominent on the back. Larvae (tadpoles) range from 14 to 80 millimeters (mm)(0.6 to 3.1 in) in length, and the background color of the body is dark brown and yellow with darker spots (Storer 1925).

California red-legged frogs have paired vocal sacs and vocalize in air (Hayes and Krempels 1986). Female frogs deposit egg masses on emergent vegetation so that the egg mass floats on the surface of the water (Hayes and Miyamoto 1984). California red-legged frogs breed from November through March with earlier breeding records occurring in southern localities (Storer 1925). Individuals occurring in coastal drainages are active year-round (Jennings *et al.* 1992), whereas those found in interior sites are normally less active during the cold season.

Adult California red-legged frogs prefer dense, shrubby or emergent riparian vegetation closely associated with deep (>0.7 m [2.3 ft]), still, or slow-moving water (Hayes and Jennings 1988). However, frogs also have been found in ephemeral creeks and drainages and in ponds that may or may not have riparian vegetation. The largest densities of California red-legged frogs currently are associated with deep pools with dense stands of overhanging willows (*Salix* spp.) and an intermixed fringe of cattails (*Typha latifolia*) (Jennings 1988). California red-legged frogs disperse upstream and downstream of their breeding habitat to forage and seek sheltering habitat. Sheltering habitat for California red-legged frogs is potentially all aquatic, riparian, and upland areas within the range of the species and includes any landscape features that provide cover, such as existing animal burrows, boulders or rocks, organic debris such as downed trees or logs, and industrial debris. Agricultural features such as drains, watering troughs, spring boxes, abandoned sheds, or hay ricks may also be used. Incised stream channels with portions narrower than 46 cm (18 in) and depths greater than 46 cm (18 in) may also provide important summer sheltering habitat. Accessability to sheltering habitat is essential for the survival of California red-legged frogs within a watershed, and can be a factor limiting frog population numbers and survival. During winter rain events, juvenile and adult California red-legged frogs are known to disperse up to 1-2 km (0.54-1.08 mi) (Rathbun and Holland, unpublished data, cited in Rathbun *et al.* 1997). Dispersing frogs in northern Santa Cruz County traveled distances from 0.4 km (0.25 mi) to more than 3 km (2 mi) without apparent regard to topography, vegetation type, or riparian corridors (Bulger, unpublished data).

Egg masses contain about 2,000 to 5,000 moderate sized (2.0 to 2.8 mm [0.08 to 0.11 in] in diameter), dark reddish brown eggs and are typically attached to vertical emergent vegetation, such as bulrushes (*Scirpus* spp.) or cattails (Jennings *et al.* 1992). California red-legged frogs are often prolific breeders, laying their eggs during or shortly after large rainfall events in late winter and early spring (Hayes and Miyamoto 1984). Eggs hatch in 6 to 14 days (Jennings 1988). In coastal lagoons, the most significant mortality factor in the pre-hatching stage is water salinity (Jennings *et al.* 1992); eggs exposed to salinity levels greater than 4.5 parts per thousand result in 100 percent mortality (Jennings and Hayes 1990). Increased siltation during the breeding season can cause asphyxiation of eggs and small larvae. Larvae undergo metamorphosis 3.5 to 7 months after hatching (Storer 1925; Wright and Wright 1949; Jennings and Hayes 1990). Of the various life stages, larvae probably experience the highest mortality rates, with less than 1 percent of eggs laid reaching metamorphosis (Jennings *et al.* 1992). Sexual maturity normally is reached at 3 to 4 years of age (Storer 1925; Jennings and Hayes 1985). California red-legged frogs may live 8 to 10 years (Jennings *et al.* 1992). Populations of California red-legged frogs fluctuate from year to year. When conditions are favorable California red-legged frogs can experience extremely high rates of reproduction and thus produce large numbers of dispersing young and a concomitant increase in the number of occupied sites. In contrast, California red-legged frogs may temporarily disappear from an area when conditions are stressful (e.g., drought).

The diet of California red-legged frogs is highly variable. Hayes and Tennant (1985) found invertebrates to be the most common food items. Vertebrates, such as Pacific tree frogs (*Hyla regilla*) and California mice (*Peromyscus californicus*), represented over half the prey mass eaten by larger frogs (Hayes and Tennant 1985). Hayes and Tennant (1985) found juvenile frogs to be active diurnally and nocturnally, whereas adult frogs were largely nocturnal. Feeding activity probably occurs along the shoreline and on the surface of the water (Hayes and Tennant 1985). Larvae likely eat algae (Jennings *et al.* 1992).

Several researchers in central California have noted the decline and eventual disappearance of California red-legged frog populations once bullfrogs became established at the same site (L. Hunt, in litt. 1993; S. Barry, in litt. 1992; S. Sweet, in litt. 1993). This has been attributed to both predation and competition. Twedt (1993) documented bullfrog predation of juvenile northern red-legged frogs, and suggested that bullfrogs could prey on subadult northern red-legged frogs as well. In addition to predation, bullfrogs may have a competitive advantage over California red-legged frogs; bullfrogs are larger, possess more generalized food habits (Bury and Whelan 1984), have an extended breeding season (Storer 1933) during which an individual female can produce as many as 20,000 eggs (Emlen 1977), and larvae are unpalatable to predatory fish (Kruse and Francis 1977). In addition to competition, bullfrogs also interfere with California red-legged frog reproduction. Both California and northern red-legged frogs have been observed in amplexus with (mounted on) both male and female bullfrogs (Jennings and Hayes 1990; Twedt 1993; M. Jennings, in litt.1993; R. Stebbins in litt. 1993). Thus bullfrogs are able to prey upon and out-compete California red-legged frogs, especially in sub-optimal habitat.The urbanization of land within and adjacent to California red-legged frog habitat has also impacted California red-legged frogs. These declines are attributed to channelization of riparian areas, enclosure of the channels by urban development that blocks California red-legged frog dispersal, and the introduction of predatory fishes and bullfrogs. This report further identifies the conversion and isolation of perennial pool habitats resulting from urbanization as an ongoing impact to California red-legged frogs.

Juvenile and adult frogs, including California red-legged frogs, have been found in human-created habitats such as golf course ponds, but these habitats may not be suitable for the long-term survival or successful reproduction of local frog populations, especially near urban areas where predators such as bullfrogs and racoons are able to build up large populations (Service 2002). In the Central Coast area of California, which contains the largest known California red-legged frog populations, California red-legged frogs are known from three golf courses (Froke pers. comm.). Two of these golf courses are also inhabited by bullfrogs, and the two species are found in separate ponds. Within Alameda and Contra Costa counties we are not aware of California red-legged frogs inhabiting ponds within golf courses. In Solano County, red-legged frogs were found in large numbers immediately after the construction of water features within one golf course, however this population has been nearly eliminated by a substantial bullfrog population, and perhaps by water chemistry manipulation by the golf course in a pond used as a watering source.

California red-legged frogs have been extirpated or nearly extirpated from over 70 percent of their former range. Historically, this species was found throughout the Central Valley and Sierra Nevada foothills. As of 1996, California red-legged frogs have been documented in approximately 240 streams or drainages from 23 counties, primarily in central coastal California. Monterey, San Luis Obispo, and Santa Barbara counties support the largest extent of currently occupied habitat. The most secure aggregations of California red-legged frogs are found in aquatic sites that support substantial riparian and aquatic vegetation and lack non-native predators. Several researchers in central California have noted the decline and eventual local disappearance of California and northern red-legged frogs in systems supporting bullfrogs (Jennings and Hayes 1990; Twedt 1993), red swamp crayfish (*Procambarus clarkii*), signal crayfish (*Pacifastacus leniusculus*), and several species of warm water fish including sunfish (*Lepomis* spp.), goldfish (*Carassius auratus*), common carp (*Cyprinus carpio*), and mosquitofish (*Gambusia affinis*) (L. Hunt, in litt. 1993; S. Barry, in litt. 1992; S. Sweet, in litt. 1993). Habitat loss, non-native species introduction, and urban encroachment are the primary factors that have adversely affected the California red-legged frog throughout its range.

The recovery plan for the California red-legged frog identifies eight recovery units. Each recovery unit reflects areas with similar conservation needs. The strategy for recovery of California red-legged frogs includes promoting and protecting populations that are geographically distributed in a manner that allows for the continued existence of viable metapopulations. The establishment of these recovery units is based on the recovery team's determination that various regional areas of the species' range are essential to its overall survival and recovery because these units will ensure that the strategy for recovery of the species will be implemented. The draft recovery plan specifies that the status of the California red-legged frog should be considered within the smaller scale of recovery units as opposed to the overall range of the species because these units reflect areas with similar conservation needs. Furthermore, this strategy will promote and protect the continued existence of viable metapopulations. These recovery units are delineated by major watershed boundaries, as defined by U.S. Geological Survey hydrologic units and California Department of Fish and Game's Ichthyological Provinces, and the limits of the range of the California red-legged frog. The goal of the recovery plan is to protect the long-term viability of all extant populations within each recovery unit. Within each recovery unit, core areas have been delineated and represent contiguous areas of moderate to high California red-legged frog densities that are relatively free of exotic species such as bullfrogs. The goal of designating core areas is to protect metapopulations that, combined with suitable dispersal habitat, will allow for the long term viability within existing populations. This management strategy will allow for the recolonization of habitat within and adjacent to core areas that are naturally subjected to periodic localized extinctions, thus assuring the long-term survival and recovery of the California red-legged frog.

The historic range of the red-legged frog extended coastally from the vicinity of Point Reyes National Seashore, Marin County, California, and inland from the vicinity of Redding, Shasta County, California, southward to northwestern Baja California, Mexico (Jennings and Hayes 1985; Hayes and Krempels 1986). The California Red-legged frog was historically documented with 46 counties but the taxa now remains in 238 streams or drainages within 23 counties, representing a loss of 70 percent of its former range (Service 2002, 61 **FR** 25813). Red-legged frogs are still locally abundant within portions of the San Francisco Bay area and the central coast. Within the remaining distribution of the species, only isolated populations have been documented in the Sierra Nevada, northern Coast, and northern Transverse Ranges. The species is believed to be extirpated from the southern Transverse and Peninsular ranges, but is still present in Baja California, Mexico (California Department of Fish and Game 2002).

The recovery plan for the California red-legged frog identifies eight recovery units (Service 2002). The establishment of these recovery units are based on the Recovery Team's determination that various regional areas of the species' range are essential to its survival and recovery. The status of the California red-legged frog will be considered within the smaller scale of Recovery Units as opposed to the overall range. These recovery units are delineated by major watershed boundaries as defined by U.S. Geological Survey hydrologic units and the limits of the range of the red-legged frog. The goal of the recovery plan is to protect the long-term viability of all extant populations within each recovery unit. Within each recovery unit, core areas have been delineated and represent contiguous areas of moderate to high California red-legged frog densities that are relatively free of exotic species such as bullfrogs. The goal of designating core areas is to protect metapopulations that, combined with suitable dispersal habitat, will allow for the long term viability within existing populations. This management strategy will allow for the recolonization of habitat within and adjacent to core areas that are naturally subjected to periodic localized extinctions, thus assuring the long-term survival and recovery of California red-legged frogs.

The Fire Management Plan is located within the North San Francisco Bay/North Coast recovery unit which includes portions of watersheds at Point Reyes National Seashore and Golden Gate National Recreation Area. Within this recovery unit, California red-legged frogs are threatened primarily by water management and diversions, non-native species, livestock, and urbanization. Populations of the California red-legged frog in this region are relatively robust where habitat is available. California red-legged frogs have been observed extensively within the boundaries of grazed and ungrazed lands within Point Reyes National Seashore and Golden Gate National Recreation Area. A number of created breeding ponds within Point Reyes National Seashore and Golden Gate National Recreation Area are at risk due to deteriorating dams.

There are recent sightings of the California red-legged frog throughout Point Reyes National Seashore, and possibly the Golden Gate National Recreation Area (California Department of Fish and Game 2004; DEIS; Service files; National Park Service undated). In addition, adult California red-legged frogs are highly mobile and may move considerable distances from their breeding ponds. Suitable habitat is found in and adjacent to the action area. Areas of containing aquatic and upland habitat exist within the action area. The action area contains components that can be used by the California red-legged frog for feeding, resting, mating, movement corridors, and other essential behaviors. Therefore, the Service believes that the California red-legged frog is reasonably certain to occur within the action area because of the biology and ecology of the animal, the presence of suitable habitat in and adjacent to the action area, as well as the recent observations of this listed species.

California Red-Legged Frog Proposed Critical Habitat

In March 2001, the final rule determining critical habitat for red-legged frogs was published in the Federal Register (66 **FR** 14626). This rule established 31 Critical Habitat Units based on three primary constituent elements: (a) essential aquatic habitat; (b) associated uplands; and (c) dispersal habitat connecting essential aquatic habitat. In November 2002, the U.S. District Court for the District of Columbia vacated most of the 2001 designation and ordered the Service to publish a new critical habitat proposal. On April 13, 2004, the Service re-proposed 4.1 million acres in 28 California counties as critical habitat for the frog (69 **FR** 19620). This proposed rule basically re-proposes the same areas designated critical habitat in the 2001 final rule. The proposed Fire Management Plan is located within one of the proposed critical habitat units.

In determining which areas to designate as critical habitat, the Service considers those physical and biological features (primary constituent elements) that are essential to the conservation of the species, and that may require special management considerations and protection (50 CFR § 424.14). The Service lists the known primary constituent elements together with the proposed critical habitat description. Such physical and biological features include, but are not limited to, space for individual and population growth and for normal behavior; food, water, air, light, minerals, or other nutritional or physiological requirements; cover or shelter; sites for breeding, reproduction, rearing (or development) of offspring; and habitats that are protected from disturbance or are representative of the historic geographical and ecological distributions of a species.

Due to the complex life history and dispersal capabilities of the California red-legged frog, and the dynamic nature of the environments in which they are found, the primary constituent elements described below are found throughout the watersheds that are proposed as critical habitat. Special management, such as habitat rehabilitation efforts (*e.g.*, removal of nonnative predators), may be necessary in the area designated. The proposed critical habitat for the California red-legged frog provides for breeding and nonbreeding habitats and for dispersal between these habitats, as well as allowing for expansion of frog populations vital to the recovery of the subspecies. The proposed critical habitat includes: (a) essential aquatic habitat; (b) associated uplands; and (c) dispersal habitat connecting essential aquatic habitat.

Aquatic habitat is essential for providing space, food, and cover, necessary to sustain all life stages of red-legged frogs. It consists of virtually all low-gradient fresh water bodies, including natural and man-made (*e.g.*, stock) ponds, backwaters within streams and creeks, marshes, lagoons, and dune ponds, except deep lacustrine water habitat (*e.g.*, deep lakes and reservoirs 123.55 ha [50 acres] or larger in size) inhabited by nonnative predators. The subspecies requires a permanent water source to ensure that aquatic habitat is available year-round. Permanent water sources can include, but are not limited to, ponds, perennial creeks, permanent plunge pools within intermittent creeks, seeps, and springs. Aquatic habitat used for breeding usually has a minimum deep water depth of 50.8 cm (20 in), and maintains water during the entire tadpole rearing season (at least March through July). During periods of drought, or less-than-average rainfall, these breeding sites may not hold water long enough for individuals to complete metamorphosis, but because they support breeding in wetter years these sites would still be considered essential breeding habitat. Ponds that support a small population of red-legged frogs, but are not surrounded by suitable upland habitat, or are cut off from other breeding ponds or permanent water sources by impassable dispersal barriers, do not have the primary constituent elements for proposed California red-legged frog critical habitat.

To be a primary constituent element for California red-legged frog proposed critical habitat, the aquatic components within the designated boundaries must include two or more breeding sites (as defined above) located within 2.01 km (1.25 mi) of each other; at least one of the breeding sites must also be a permanent water source; or, the aquatic component can consist of two or more seasonal breeding sites with a permanent nonbreeding water source located within 2.01 km (1.25 mi) of each breeding site. California red-legged frogs have been documented to travel 3.62 km (2.25 mi) in a virtual straight line migration from nonbreeding to breeding habitats (66 **FR** 14626). In addition, breeding sites must be connected by dispersal habitat connecting essential aquatic habitat, described below.

Associated upland and riparian habitat is essential to maintain California red-legged frog populations associated with essential aquatic habitat. The associated uplands and riparian habitat provide food and shelter sites for California red-legged frogs, and assist in maintaining the integrity of aquatic sites by protecting them from disturbance and supporting the normal functions of the aquatic habitat. Key conditions include the timing, duration, and extent of water moving within the system, filtering capacity, and maintaining the habitat to favor red-legged frogs and discourage the colonization of nonnative species such as bullfrogs. Essential upland habitat consists of all upland areas within 91.5 m (300 ft), or no further than the watershed boundary, of the edge of the ordinary high-water mark of essential aquatic habitat (66 **FR** 14626).

Essential dispersal habitat provides connectivity among California red-legged frog breeding habitat (and associated upland) patches. While frogs can pass many obstacles, and do not require a particular type of habitat for dispersal, the habitat connecting essential breeding locations and other aquatic habitat must be free of barriers (*e.g.*, a physical or biological feature that prevents frogs from dispersing beyond the feature) and at least 91.5 m (300 ft) wide. Essential dispersal habitat consists of all upland and wetland habitat free of barriers that connects two or more patches of essential breeding habitat within 2.01 km (1.25 mi) of one another. Dispersal barriers include heavily traveled roads (an average of 30 cars per hour from 10:00 p.m. to 4:00 a.m.) that possess no bridges or culverts; moderate to high density urban or industrial developments; and large reservoirs more than 123.55 ha (50 acres) in size. Agricultural lands such as row crops, orchards, vineyards, and pastures do not constitute barriers to California red-legged frog dispersal.

Point Reyes National Seashore and the Golden Gate National Recreation Area occur within the proposed Point Reyes Unit (Unit 12), which consists of watersheds within and adjacent to Bolinas Lagoon, Point Reyes, and Tomales Bay in Marin and Sonoma counties. This proposed unit encompasses approximately 81,168 ha (200,572 acres); 44 percent is managed by the National Park Service, California Department of Parks and Recreation, and the Marin Municipal Water District, and 56 percent is privately owned. The proposed Unit 12 is known to be occupied by several populations of the California red-legged frog. Essential breeding habitat is dispersed throughout the proposed unit. This proposed unit contains one of the largest known populations of the California red-legged frog.

Effects of the Proposed Action

Myrtle's silverspot butterfly

Burning activities within the habitat of the silverspot may result in the incineration of eggs, larvae, and adults, or the injury or death of these life history stages due to smoke inhalation. Insects breathe via spiracles and inhalation of small particles could prevent their respiration and result in their asphyxiation. In addition, the foodplants of the larvae and/or adult nectar plants could be eliminated by burning. Eggs, larvae, and pupae also may be killed as a result of being trampled or killer by during the maintenance of fire roads and trails, and during mechanical treatments. Although surveys will be conducted for the western dog violet, the foodplant of the larvae, between March 1 and August 31, during the remainder of the year the plant dries out and is difficult to locate; in addition, the early stages of this animal are highly cryptic and often overlooked by non-specialists. However, the Fire Management Plan will eliminate invasive exotic plants that compete with native plants utilized by all life history stages of Myrtle's silverspot butterfly and thus result in significant long-term benefits to the survival and recovery of this listed animal in the wild.

California Red-legged Frog

Considering Point Reyes National Seashore and the northern unit of the Golden Gate National Recreation Area supports some of the most robust California red-legged frog populations in the State, and fire is an important component of natural ecosystems in this region of California, the Fire Management Plan will result in long-term beneficial effects to the listed amphibian. In fact, fire likely is very important for maintaining the habitats of the California red-legged frog. However, in the short term, heat and smoke from the fires may kill or injure individuals. Adults or early stages of the California red-legged frog may be adversely affected by increased levels of sedimentation into aquatic habitats caused by runoff from burned areas. If heavy sedimentation occurs in pools where California red-legged frogs breed, it is possible that California red-legged frog egg masses will suffocate from being buried under sediments. Without adequate measures, heavy loss of sediments from the streambed may result in down-cutting of channels which could further degrade the stability of banks, and functions of the riparian ecosystem.

The maintenance of fire roads and trails, and mechanical treatments may result in killing or injuring California red-legged frogs which may be present during grading, vegetation removal or clearing, mowing, and other related activities. Clearing of vegetation (i.e., mowing, grubbing, etc.) may result in harm, harassment, or killing of California red-legged frogs. In addition, vehicular use of fire roads and other roads may result in mortality or injury of California red-legged frogs which may disperse across such roads.

California Red-legged Frog Proposed Critical Habitat

There will be effects to the proposed critical habitats in the sense that some primary constituent elements, notably upland and dispersal habitat, and perhaps breeding habitat will be disturbed. However, these effects are anticipated to be temporary in nature, and the proposed Fire Management Plan is anticipated to significantly improve the quality of the proposed critical habitat for the threatened California red-legged frog.

Cumulative Effects

Cumulative effects include the effects of future State, Tribal, local or private actions that are reasonably certain to occur in the action area considered in this biological opinion. Future Federal actions that are unrelated to the proposed action are not considered in this section because they require separate consultation pursuant to section 7 of the Act.

Land adjacent to and in the vicinity of Point Reyes National Seashore and the northern units of the Golden Gate National Recreation Area are owned by the California Department of Parks and Recreation, been purchased by non-profit groups for conservation purposes, or are otherwise unlikely to be converted to large scale developments. The Audubon Canyon Ranch includes an inholding on Bolinas Lagoon that connects the Golden Gate National Recreation Area to ands adjoining it. Other Audubon Canyon Ranch holdings on Tomales Bay protect undeveloped Bay frontage adjoining State Park lands. The Vedanta Society holds a 5295.35 ha (2,143 acre) parcel in the Olema Valley bounded by National Parks lands.

In 1971, the Marin County Supervisors enacted A-60 zoning (one house per 148.26 ha [60 acres]) for much of western Marin County, significantly limiting the development of agricultural properties. This zoning covers extensive areas of private lands adjoining public park and watersheds, including San Geronimo Valley, Nicasio Valley, and the northwestern portion of the County. Since 1971, zoning for the west Marin Planning Area has been elaborated to include a variety of zoning densities in areas adjacent to established towns, with minimum lot sizes ranging from one unit per acre to one unit per 148.26 ha (60 acres). The County's Local Coastal Program provides additional protection for streams, lagoons, Tomales Bay, and wetlands. The integrity of ranch and other agricultural lands is addressed in the agricultural element of the Countywide plan.

Agricultural lands in west Marin County have been and continue to be at risk of being broken up into large residential lots. The Marin Agricultural Land Trust has been acquiring development rights to agricultural land since 1980. At present, this non-profit organization holds the rights for over 74130 ha (30,000 acres) on 43 ranches in western Marin County.

The application of pesticides, herbicides, or fertilizers could degrade surface water quality in wetlands, including creeks and streams. Water quality may become impaired when pesticides/fertilizers or sediment enters the proposed project from the surrounding residential area.

Urban development results in increased numbers of pets. Both feral and domestic cats (*Felis catus*) and dogs (*Canis domesticus*) prey on aquatic and riparian species such as the California red-legged frog. People exploring creeks can harass, collect, and kill California red-legged frogs. Many flood control projects replace natural streams with engineered channels and isolate them from their natural floodplains, disrupting natural hydrologic processes and degrading stream habitat. Flood channel maintenance often requires the removal of emergent aquatic and riparian vegetation, making these channels less suitable for California red-legged frogs.

Non-native species that prey upon, or compete with, California red-legged frogs continue to be released into the environment. Releases are likely to increase with an increasing number of people living in an area. Bullfrogs, goldfish, mosquitofish , and warm water game fish species are all expected to continue to persist in the wild and degrade the quality of California red-legged frog habitat. The introduced animals may also act as disease vectors and impact threatened/endangered species.

Conclusion

After reviewing the current status of the Myrtle's silverspot butterfly and the California red-legged frog, the environmental baseline for the action area, the effects of the proposed action and the cumulative effects, it is the Service's biological opinion that the Fire Management Plan at Point Reyes National Seashore and the northern unit of the Golden Gate National Recreation Area in Marin County, California, as proposed, is not likely to jeopardize the continued existence of these two species. The proposed project is not likely to destroy or adversely modify proposed California red-legged frog critical habitat. Critical habitat has not been designated or proposed for Myrtle's silverspot butterfly; therefore, none will be affected.

INCIDENTAL TAKE STATEMENT

Section 9(a)(1) of the Act and Federal regulation pursuant to section 4(d) of the Act prohibit the take of endangered and threatened fish and wildlife species without special exemption. Take is defined as harass, harm, pursue, hunt, shoot, wound, kill, trap, capture or collect, or to attempt to engage in any such conduct. Harass is defined by the Service as an intentional or negligent act or omission which creates the likelihood of injury to a listed species by annoying it to such an extent as to significantly disrupt normal behavioral patterns which include, but are not limited to, breeding, feeding, or sheltering. Harm is defined by the Service to include significant habitat modification or degradation that results in death or injury to listed species by impairing behavioral patterns including breeding, feeding, or sheltering. Incidental take is defined as take that is incidental to, and not the purpose of, the carrying out of an otherwise lawful activity. Under the terms of section 7(b)(4) and section 7(o)(2), taking that is incidental to and not intended as part of the agency action is not considered to be prohibited taking under the Act provided that such taking is in compliance with this Incidental Take Statement.

The measures described below are non-discretionary, and must be implemented by the National Park Service that they become binding conditions of any contract, grant, or permit issued to a contractor or applicant, as appropriate, in order for the exemption in section 7(o)(2) to apply. The National Park Service has a continuing duty to regulate the activity covered by this incidental take statement. If the National Park Service (1) fails to adhere to the terms and conditions of the incidental take statement in this biological opinion, and/or (2) fails to retain oversight to ensure compliance with these terms and conditions, the protective coverage of section 7(o)(2) may lapse.

Amount or Extent of Take

The Service anticipates incidental take of Myrtle's silverspot butterfly and the California red-legged frog will be difficult to detect or quantify because of: the elusive nature of these species, relative size, and cryptic coloration which make the finding of a dead specimen unlikely. However, the level of take of each of these two species can be anticipated by the temporal effects to cover, foraging and breeding habitat. Conservation measures proposed by the National Park Service and described above in the *Description of the Proposed Action* will substantially reduce, but do not eliminate, the potential for incidental taking of these listed species. The Service, therefore, anticipates incidental take will result from the proposed project.

Upon implementation of the reasonable and prudent measures, take in the form of injury, death, harm, and harassment of the California red-legged frog and Myrtle's silverspot butterfly on 8648.5 ha (3,500 acres) per year (52130.44 ha [21096.9 acres] total) will become exempt from the prohibitions described under section 9 of the Act for direct and indirect effects associated with the Fire Management Plan.

Incidental take of the California red-legged frog and Myrtle's silverspot butterfly is expected in the form of:

1. thirty-five (35) California red-legged frogs per year may be killed or injured as a result of activities associated with the Fire Management Plan;

2. An unlimited number of individuals of all life history stages of Myrtle's silverspot butterfly will be killed, injured, harassed, or harmed as a result of the Fire Management Plan;

3. An unlimited number of the California red-legged frog will be harassed or harmed as a result of the Fire Management Plan.

Effect of the Take

The Service has determined that this level of anticipated take is not likely to result in jeopardy to the California red-legged frog and Myrtle's silverspot butterfly or result in destruction or adverse modification of proposed critical habitat for the California red-legged frog. Critical habitat for Myrtle's silverspot butterfly has not been designated or proposed, therefore none will be affected.

Reasonable and Prudent Measures

The Service believes the following reasonable and prudent measure is necessary and appropriate to minimize the impact of take on the California red-legged frog and Myrtle's silverspot butterfly:

> Minimize the potential for harm, harassment, injury, or mortality of Mrytle's silverspot butterfly and the California red-legged frog.

Terms and Conditions

To be exempt from the prohibitions of Section 9 of the Act, the National Park Service shall ensure compliance with the following terms and conditions, which implement the reasonable and prudent measures described above. These terms and conditions are nondiscretionary.
The following terms and conditions will implement the Reasonable and Prudent Measure described above:

1. The proposed project shall be implemented as described in the DEIS, and the April 1, 2004, letter from the National Park Service, and the *Project Description* of this biological opinion.

2. An education program for the field personnel involved with the Fire Management Plan shall be conducted prior to the initiation of field activities. The program shall consist of a brief presentation by a person(s) knowledgeable in the Myrtle's silverspot butterfly, the California red-legged frog, and other appropriate listed species. The program shall include the following: a description of these species and their ecology, and habitat needs; an explanation of their legal status and their protection under the Act; and a explanation of the measures being taken to avoid or reduce effects to these species during the Fire Management Plan. The education may be conducted in an informal manner (e.g., ranger and field personnel in a rural setting).

Reporting Requirements

The Service must be notified within 24 hours of the finding of any injured or dead Myrtle's silverspot butterfly or California red-legged frog, or any unanticipated damage to their habitats associated with the proposed project. Notification must include the date, time, and precise location of the specimen/incident, and any other pertinent information. The Service contact person is the Chris Nagano, Deputy Assistant Field Supervisor (Endangered Species) at the Sacramento Fish and Wildlife Office at 916/414-6600. Any dead or injured specimens should be deposited with Scott Heard, Resident Agent-in-Charge of the Service's Division of Law Enforcement, 2800 Cottage Way, Room W-2928, Sacramento, California 95825, telephone 916/414-6660.

CONSERVATION RECOMMENDATIONS

Section 7(a)(1) of the Act directs Federal agencies to utilize their authorities to further the purposes of the Act by carrying out conservation programs for the benefit of endangered and threatened species. Conservation recommendations are discretionary agency activities to implement recovery actions, to help implement recovery plans, to develop information, or otherwise further the purposes of the Act.

For the Service to be kept informed of actions minimizing or avoiding adverse effects or benefiting listed species or their habitats, we request notification of the implementation of any of the conservation recommendations. We propose the following conservation recommendations:

1. The Service recommends the National Park Service implement the appropriate actions described in the *Recovery Plan for the California red-legged frog (Rana aurora draytonii)*.

2. The Service recommends the National Park Service implement the appropriate actions described in the *Recovery Plan for Seven Coastal Plants and the Myrtle's Silverspot Butterfly*.

3. The National Park Service should continue to encourage or require the use of appropriate locally collected California native plants in the restoration or enhancement of native species diversity and ecosystem functions at Point Reyes National Seashore and Golden Gate National Recreation Area.

4. The law enforcement rangers of the National Park should continue their vigilance for individuals who collect the endangered Myrtle's silverspot butterfly, other listed and rare butterflies without authorization on National Park Service lands. Illegal collection of butterflies has been documented by the Service to have occurred at Point Reyes National Seashore and Fort Baker (Cavallo Point) at the Golden Gate National Recreation Area.

REINITIATION STATEMENT

This concludes formal consultation on the proposed Fire Management Plan at Point Reyes National Seashore and the northern unit of the Golden Gate National Recreation Area in Marin County, California. As provided in 50 CFR § 402.16, reinitiation of formal consultation is required where discretionary Federal agency involvement or control over the action has been retained (or is authorized by law) and if: (1) the amount or extent of incidental take is exceeded; (2) new information reveals effects of the agency action that may affect listed species or critical habitat in a manner or to an extent not considered in this opinion; (3) the agency action is subsequently modified in a manner that causes an effect to the listed species or critical habitat not considered in this opinion; or (4) a new species is listed or critical habitat designated that may be affected by the action.

If you have any questions regarding this biological opinion on the proposed Fire Management Plan, please contact Chris Nagano, Deputy Assistant Field Supervisor (Endangered Species) or Roberta Gerson (northern spotted owl), Chief of our Forest-Foothill Branch, at the letterhead address or at 916/414-6600.

cc:
USNPS, GGNRA, San Francisco, CA (Attn: Superintendent B. O'Neill)
USNPS, PRNS, Point Reyes Station, CA (Attn: Ranger S. Allen)
USNPS, GGNRA, San Francisco, CA (Attn: Ranger N. Hornor)
USNPS, GGNRA, San Francisco, CA (Attn: Ranger D. Hatch)
USNPS, GGNRA, San Francisco, CA (Attn: Ranger D. Fong)
USGS, Point Reyes Station, CA (Attn: G. Fellers)

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